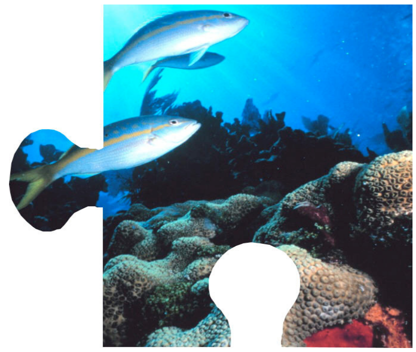
IUCN World Commission on Protected Areas-Marine (WCPA-Marine)
World Wide Fund for Nature (WWF) Endangered Seas Programme
National Oceanic and Atmospheric Administration (NOAA)



How Is Your MPA Doing?

A Guidebook

Biophysical, Socioeconomic, and Governance Indicators for the Evaluation of Management Effectiveness of Marine Protected Areas

Working Draft

Version: 31 December 2002

Robert S. Pomeroy, John E. Parks, and Lani M. Watson

An Invitation to the Reader

This Working Draft Guidebook (version 31-Dec-02) is a result of the activities of the International Marine Protected Area (MPA) Management Effectiveness Initiative developed by the World Commission on Protected Areas-Marine (WCPA-Marine) and the World Wide Fund for Nature (WWF). Between October 2002 and March 2003, this working draft will be used and field-tested at different pilot MPA projects around the world. The working draft is open for review from the international MPA community and comments are welcome. Please submit any comments before March 1st, 2003, to the one of the following addresses:

email: mei_core_team@noaa.gov
mail: WCPA-Marine/WWF MPA Management Effectiveness Initiative
NOAA-NOS International Programs Office
1315 East West Highway, SSMC-3, 5th Floor
Silver Spring, MD 20910 USA

This working draft will be revised based on feedback from the pilot projects and external reviews. The final version will be published in July 2003 and will be distributed during the World Park Congress, to be held in Durban, South Africa on September 2003.

Acknowledgments

This project was made possible through the generous support of the:

- David and Lucille Packard Foundation
- National Oceanic & Atmospheric Administration's (NOAA) National Ocean Service
- World Wide Fund for Nature (WWF)

The authors want to thank to the following people, who reviewed and provided substantial comments on the working draft of the guidebook:

Tundi **Agardy**
Antonio **Arujo**
Matt **Brookhart**
Leah **Bunce**
Ratana **Chuenpagdee**
Athline **Clark**
Terry **Donaldson**
Terry **Done**
Leanne **Fernández**
Peter **Graham**
Marc **Hockings**
Janice **Hodge**
Mike **Mascia**
Tyler **McAdam**
Patrick **McConney**
Melanie **McField**
John **Munro**
John **Ogden**
Arthur **Paterson**
Richard **Pollnac**
Jason **Rubens**
Enric **Sala**
Rodney **Salm**
Leonid **Shabad**
Vassily **Spiridonov**
Jack **Sobel**
Ed **Tongson**
Mark **Tupper**
Andre Jon **Uychiaco**
Carlos **Valle**

Cover designed by Gonzalo Cid (NOAA). Cover photographs were obtained courtesy of the NOAA Photo Library.

WCPA-Marine & WWF
International MPA Management Effectiveness Initiative

How Is Your MPA Doing?

A Guidebook

Biophysical, Socioeconomic, and Governance Indicators for the Evaluation of Management Effectiveness of Marine Protected Areas

Working Draft Version: 31 December 2002

Authors

Robert S. Pomeroy, PhD
University of Connecticut (UConn)
+1 (860) 405-9215
Robert.Pomeroy@Uconn.edu

John E. Parks
Community Conservation Network (CCN)
+1 (808) 528-3700
John@conservationpractice.org

Lani M. Watson
NOAA National Ocean Service
+1 (301) 713-3078 ext. 223
Lani.Watson@noaa.gov

Project Co-Chairs

Charles (Bud) Ehler
Vice-Chair, WCPA-Marine
Director, NOAA-NOS International Program Office
Charles.Ehler.IUCN@noaa.gov

Simon Cripps, PhD
Director
WWF Endangered Seas Programme
Scripps@wwfint.org

Core Team

Lani Watson, NOAA (project manager)
Miguel Jorge, WWF
Gonzalo Cid, NOAA
Marcia Cota, WWF
Robert Pomeroy, PhD, UConn
John Parks, CCN
Leah Bunce, PhD, NOAA
Steve Morrison, NOAA

Table of Contents

Preface

*[@@@ **NOTE TO THE READER**: In this working draft, editorial comments and sections still under development are highlighted in italicized text within brackets. Note that the final version of this manuscript will have addressed all of these points.]*

[@@@ Preface to be inserted]

[@@@ Acknowledgements page to be inserted; include organizations]

CHAPTER ONE: Introducing this Guidebook and How to Use It

This guidebook offers managers and other conservation practitioners[1] with a process to measure the effectiveness of marine protected area management. It includes indicators to measure effectiveness of goals and objectives specific to marine protected areas, the marine environment and coastal communities. This guidebook provides a flexible approach applicable to a wide range of marine protected area types (e.g., multiple-use areas, marine parks, no-take areas). It outlines a process for marine protected area (MPA) managers and staff to choose indicators that are most appropriate to their sites based on site needs and resources. It is neither prescriptive nor outlines a single process that can be applied universally to all MPAs world wide.

There is strong consensus and a growing volume of scientific evidence and literature that identifies the need of MPAs and the value that MPAs provide. There are also existing guidelines on how best to design and manage MPAs (e.g., Salm *et al.* 2000; Kelleher 1999; Kelleher and Kenchington 1991). This guidebook assumes that the reader is already familiar with this literature and is actively managing or working with the implementation of a MPA and therefore focuses specifically on looking at whether the desired outcomes of a MPA are being achieved.

1.1 Why Evaluate Our Effectiveness?

Marine and coastal resource management has evolved into a professional practice more recently than in terrestrial settings where the evolution of contemporary land use and protected areas management has occurred over a few centuries of learning, adaptation, and refinement. Today there is growing recognition on the need for coastal managers and marine conservation practitioners to be more systematic in their use of tools – particularly MPAs – so as to improve marine conservation learning and create a set of best management practices. To meet this need, there is now general consensus among conservation practitioners that empirically-based performance monitoring and evaluation will improve MPA use and strengthen managers' abilities to achieve core management goals and objectives. It is particularly relevant now given: (a) the opportunistic and *ad hoc* proliferation that MPA use has experienced as a consequence of improved scientific documentation of protection benefits, and (b) increasing evidence of how this proliferation is generating 'paper parks' that in some cases may be little more than legal declarations returning mixed to few or no desired outcomes as a result of poor management and design (Burke *et al.* 2002).

Managing MPAs is a continuous, iterative, adaptive, and participatory process comprised of a set of related tasks or elements that must be carried out to achieve a desired set of objectives. The management process involves planning and design, implementation, monitoring, evaluation, communication and adaptation. Evaluation consists of reviewing results of actions taken and assessing whether these actions have produced the desired outcomes – this helps managers to adapt and improve by learning. Evaluation is a routine part of the adaptive management process and is something that most managers already do where the link between actions and consequences can be

[1] Terms introduced in this guidebook are underlined, highlighting their link to the glossary where they are defined.

Box 1. What is a 'Marine Protected Area'?

This guidebook focuses on marine (rather than terrestrial) protected areas because of the:

- Unique challenges and management approaches required in a marine setting that differ from terrestrial protected areas, and
- Increasing global demand, interest, and application in marine protection.

There is occasional debate among marine researchers and conservation practitioners as to the precise definition of a 'marine protected area'. This guidebook follows the accepted IUCN (1998) definition of a marine protected area (MPA) as:

"Any area of intertidal or subtidal terrain, together with its overlying waters and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment."

Generally speaking, natural resources management and conservation largely occurs through four general *strategies*, or types of management actions undertaken:

- direct protection,
- legal regulation and policy,
- economic incentives, and
- education and awareness.

These four management strategies can be applied as equally in a marine setting for a coral reef ecosystem as they can be in a terrestrial one for an inland forest. In this regard, a MPA is one specific type of management *tool* that is available, for example, to a conservation practitioner who chooses to employ a direct protection strategy somewhere in the costal zone where they are working. Further, "marine protected area" is used as an umbrella term under which various types and degrees of protection can be zoned and used, such as multiple use areas, general use areas, or no-take areas (reserves).

Natural resource managers are trained to use a mix of management strategies, given that no one strategy alone is sufficient to result in sustainable use, but rather that an appropriate mix of these strategies must be determined and employed at a site, depending on the operating conditions and the actors involved. In the real world, one cannot assume that a MPA (as one tool under a direct protection strategy) will be used alone and in isolation from environmental education programs, alternative enterprise development projects, or policy reform. While the focus of this guidebook is on marine protection, it is important to consider the complementary use of other management tools and strategies to MPAs.

simply observed. However, the link between actions and outcomes is often not so obvious. Faced with the daily demands of their jobs, many managers are not able to monitor systematically and review the results of their efforts. In the absence of such reviews, money and other resources can be wasted on programs that do not achieve their objectives. Therefore it is important to allocate resources towards evaluation across all functions of MPAs in order to learn from success and failures and to keep track of changes in management practices so that people can understand how management is being undertaken.

There are a number of excellent reference materials available to practitioners on monitoring and evaluation and the use of performance indicators, particularly from a terrestrial conservation experience and perspective. A number of these useful references can be found listed in Chapter Six.

Adaptive management is a fundamental concept underlying the rationale for this guidebook. The use of adaptive management in a conservation context is well documented in the literature (Salafsky *et al.* 2001; Hockings *et al.* 2000; Renzi 1998; Lee 1993), and essentially reflects the cyclical process of systematically testing assumptions, generating learning from evaluating results of such testing, and further revising and improving management practices. The result of adaptive management in a protected area context is improved effectiveness and increased levels of achievement toward goals and objectives. This iterative process of evaluation and improvement in protected areas use is being actively promoted by the World Conservation Union (IUCN) and its member organizations world wide. A more detailed discussion on the use of this guidebook for adaptive management of MPAs is included in Chapter Four.

A word of caution in undertaking what is outlined in this guidebook. Performance evaluation is often characterized and perceived as a cumbersome, superfluous, and overly technical activity that requires the involvement of outside 'specialists'. Indeed for some, merely the word "evaluation" carries worrisome overtones of supervision, discipline, and potential punishment. Readers are cautioned to be aware and sensitive of this in deciding to undertake the activities outlined in this reference, particularly when evaluating involves the interaction and survey of stakeholders who may not fully understand the adaptive management benefits of performance evaluation. As this guidebook aims to encourage and allow practitioners to empower *themselves* (as opposed to outsiders) to improve the performance and impacts of their MPA, it is suggested that any introduction into undertaking an 'evaluation' be predicated on the dual aims of self-empowerment and improved conservation success.

1.2 What is 'Management Effectiveness'?

The past twenty five years have witnessed a global proliferation of terrestrial and marine protected area application. Correspondingly, there has been increasing interest in determining both which management approaches are most effective for protected areas and how to improve the use of these approaches. Out of this interest arose the need to develop an approach for evaluating protected areas effectiveness.

In 1997, IUCN's World Commission on Protected Areas (WCPA) created a task force of nearly 30 experts in protected areas management from 17 countries to address this need. This 'Management Effectiveness Task Force' was charged with developing a set of guidelines that protected area managers and other conservation practitioners could use to measure and evaluate the effectiveness of their management actions. The fundamental idea behind this international effort was to provide people with the tools necessary to better understand and improve protected areas use world-wide.

Following three years of extensive research, work, and testing, the IUCN Task Force released a set of general guidelines to help managers and practitioners think about how best to evaluate the effectiveness of the protected areas they are implementing. This publication is entitled "Evaluating Effectiveness: A Framework for Assessing the Management of Protected Areas" (Hockings *et al.* 2000), and serves as an important introduction to protected area managers and practitioners as to the need, complexity, and approach of evaluating management effectiveness.

Management effectiveness can be thought of as the degree to which a protected area is used to achieve it's goals and objectives. Assessing management effectiveness is a way to document how the management of a protected area ultimately influences its success. This is important because: (a) it allows for the improvement of protected area use through learning and adaptation, (b) it allows for the diagnosis of specific issues influencing the success of a protected area in achieving its goals and objectives, and (c) it assumes that the managers, supporters, and other stakeholders who are involved in the use of protected areas have an impact on the degree of conservation success achieved.

It should be noted that a management effectiveness evaluation is different from a monitoring and evaluation program of the MPA. Whereas evaluating management effectiveness measures the degree to which the MPA is achieving its goals and objectives, a monitoring program is much broader in scope. A monitoring and evaluation program measures the achievement of goals and objectives, but it also is used to keep track of the implementation of activities and to evaluate the success or failure of the activities. Adequate monitoring allows the activities of the MPA to be fine-tuned and to be more effective. A management effectiveness evaluation, while being independent, should also be considered as part of the MPAs monitoring and evaluation program.

Evaluating a protected area's management effectiveness is not necessarily an easy task, particularly given: (a) the need to appropriately, accurately, and objectively assess the degree of achievement and its reflection on those who manage it or external stakeholders, and (b) the fact that natural disturbances and global influences can often radically alter ecosystems regardless of how well a protected area is being managed. In order to empower practitioners with the ability to diagnose and adaptively improve their management actions, the IUCN management effectiveness guidelines frame three sets of simple questions in order begin evaluating management effectiveness:

(1) In terms of the **design** of the protected area:

- What is the *context* in which the protected area is undertaken?
- What is the desired result and how will *planning* allow for it's achievement?

(2) In terms of how appropriate the management **system and process**:

- What *inputs* are required in undertaking the protected area?
- What is the *process* used to go about undertaking it?

(3) In terms of the **achievement** of desired objectives:

- What activities were undertaken and what were the *outputs* (products) of this?
- What *outcomes* (impacts) were achieved based on the outputs and their application?

These questions are developed from the recognized, iterative management cycle of protected area design, management, monitoring, evaluation, and adaptation. From these questions arises a framework of six categories of potential indicators that evaluators can focus on in measuring management effectiveness:

- **Context** indicators
- **Planning** indicators
- **Input** indicators
- **Process** indicators
- **Output** indicators
- **Outcome** indicators

Using this general framework allows protected area managers to customize a set of appropriate performance indicators to be used at relevant scales. The framework also serves as a foundation from which to further investigate a specific category of indicators (e.g., outcomes) or to determine which indicators are most appropriate based on the use of a specific protected area tool. The framework provides a common language and an important structure from which to improve protected areas precision, learning, efficacy, and achievement. As a framework in how to design an evaluation approach – rather than providing a specifically defined set of indicators and methodologies to measure them – the tool accounts for variation in the context, available resources, evaluative purpose, and specific management objectives across protected areas.

The framework is a starting point to address the improvement of protected areas management, and this guidebook builds on that framework to address particular issues for MPAs. For example, it is uncertain to what degree the methods in measuring management effectiveness are applicable and can be transferred across habitat types and biomes. Similarly, it is not yet clear what lessons regarding effective protected area management are as applicable in a marine setting as they are in a mountainous one. Further, can a set of generalized indicators be standardized and useful under all protected area contexts? These are just some of the challenges facing practitioners in their improvement of protected area use.

This Guidebook should be used along with other references on this subject. Other useful works on monitoring and evaluating, management effectiveness, and measuring conservation impact are listed in Chapter Six. Some of these are specific to MPA and other protected area use.

1.3 Purpose of This Guidebook

The purpose of this guidebook is to assist managers and other conservation practitioners to evaluate and adaptively improve the effectiveness of MPA implementation and management. To do this, a discrete set of 44 biophysical, socioeconomic, and governance performance indicators are presented that can be used by practitioners all over the world to evaluate MPAs.

MPAs are established for many different reasons all over the world. Accordingly, the 44 indicators presented in this guidebook arise from and reflect a wide diversity of goals and objectives in using MPAs. The idea of this guidebook is *not* to outline every possible indicator or identify some minimum set that must be collected, but rather to present a set of indicators that likely match up with at least *some* of the specific goals and objectives underlying most MPAs, particularly those that can be of most use to and easily referenced by interested practitioners. In this regard, this book is meant to be flexible enough to include a wide range of MPA types and allow the reader to select the indicators that are most appropriate to the needs and resources at their site.

The indicators presented in this guidebook intend to *demonstrate* effective MPA management, not predict it. In other words, the biological, socioeconomic, and governance aspects measured using the methods outlined here are thought to be *indicative of MPA success*, not foretelling of whether or not the MPA will work or be effectively managed in the future. For example, if the indicator for increased abundance of an important resource population (Biophysical Indicator One) is found to be higher in the MPA than outside it, then the team using the indicator might say that this is indicative of some level of effective management of the area declared. However, their measurement of this indicator is not intended to predict that management effectiveness and MPA success will occur. However, some – if not many – of the aspects that the indicators attempt to measure could be (and in some cases have already been shown to be) sound predictors of MPA success as a desired outcome.

The 44 indicators span all six indicator categories identified in the IUCN Framework (see table in Appendix One). However, the indicators presented in this guidebook are largely oriented toward measuring MPA outputs (such as products or raw results) and outcomes (such as impacts and learning). This is for two reasons: First, context, planning, input, and process indicators for general protected area use appear to be highly universally applicable across biomes and protection approaches, and as they are already well documented elsewhere in the literature, they are not repeated here. A list of these citations and the indicators they contain can be found in Chapter Six. Second, government, MPA practitioners, and the public need to strengthen MPA management and better understand the conservation and socioeconomic impacts and benefits of marine and coastal area management. As a result, this guidebook is heavily oriented toward output and outcome indicator measurement. Therefore, the references listed in Chapter Six supplement the indicators presented in this guidebook and will provide for a comprehensive approach to selecting and measuring necessary indicators across all six categories.

This being said, measuring outputs and outcomes alone are insufficient to explain effective management. For example, without understanding the context or process underlying the management of a MPA, a manager may not understand why or why not a specific outcome is observed through the use of the indicators outlined here. It is in this explanatory meaning that the other context, planning, process, and input indicators become essential components to a full understanding of what is happening in a MPA (see Hockings *et al.* 2000 for more information and a workbook on this).

1.4 How to Use This Guidebook

As discussed previously, the purpose of this guidebook is to assist managers and conservation practitioners in improving their effectiveness of MPA implementation and management through the evaluation of simple but meaningful performance indicators. Before discussing what these indicators are and how to plan for using them at a particular MPA site, it is important to first outline the approach to using this guidebook.

Box 2. Key Principles in Undertaking an Evaluation with this Guidebook

This guidebook is founded on five key principles to ensure that the evaluation process is:

- Useful
- Practical
- Balanced
- Flexible
- Holistic

These principles are important because they help the reader to better understand how and why the guidebook was created, as well as identify how and how not it should be used. These principles should also be applied to the design of an evaluation.

Principle One: *Useful*

- The guidebook should be useful to MPA managers and marine conservation practitioners. Using it should be an educational and rewarding experience that leads to the improvement of management actions and the achievement of higher degrees of conservation success. Results generated from following the guidebook should provide a clearer understanding of the wide variety of influences and challenges facing MPAs.
- The guidebook should be useful to those who support MPA use including decision-makers, government agencies, donors, non-government organizations, and the public. This may help these audiences to more effectively support marine protection and also provide for an informed and fair degree of accountability over MPA uses.
- If properly adapted, some of the indicators in the guidebook should be useful to evaluate other management actions and scenarios in non-marine settings.
- Inevitably, the usefulness of this guidebook will be determined by the degree to which it can be directly linked to improved MPA use and management.

Principle Two: *Practical*

- The guidebook is *not* intended to be used prescriptively. As each site is unique, the indicators here are *not* universally applicable or appropriate to all MPAs. Likewise, there is no single set of compulsory indicators that must be used in order to evaluate how effective MPAs are.
- This guidebook is structured as a "cook book" of different evaluative recipes to be chosen by the reader and their constituents based on which "ingredients" (indicators) are of most *importance* to measure given their site. This should allow the reader to identify the most essential pieces of information that they need to collect in order to demonstrate the effectiveness of their actions.
- This guidebook cannot and should not be used in isolation as a "scorecard" to compare different MPAs or determine whether or not to suspend MPA action or support. However, a "scorecard" approach may be useful at a single MPA site for comparative purposes through time (requiring iterative measuring of the same indicators at set time intervals).
- The indicators should allow for maximum return on results with minimum cost.

Box 2. (Continued)

Principle Three: *Balanced*

The indicators and evaluative process in this guidebook are designed to be both:

- Sufficiently grounded in science (empirical, independently verifiable evidence) so as to allow for precision and validity in the evaluation results drawn.
- Sufficiently grounded in participation so as to allow for the inclusion, contribution, and consideration of parties that may not necessarily be familiar with scientific inquiry.

The guidebook should strike a balance between the needs for scientific rigor and public accessibility. As such it recognizes the value of both:

- Science as a valued and trusted partner in practitioners' abilities to logically guide their management actions and make decisions.
- The consideration and participation of the people and communities (the stakeholders) living in or near the MPA in the evaluation and adaptation of management practices.

Principle Four: *Flexible*

- Given global diversity and site-specificity, the indicators should be flexible enough to be applied despite unique conditions and challenges at different MPAs.
- This guidebook should be seen as a "living" document, and the indicators should be subject to periodic adaptation and improvement based on the direct learning from those practitioners who are using the indicators.
- The indicators here are only a starting point, and it is ultimately hoped that MPA practitioners will be able to move well beyond what is outlined in this guidebook.
- This guidebook is *not* a "one-stop-shop" for MPA evaluation. This guidebook should be used in conjunction with and in reference to the many other useful monitoring and evaluation tools and complementary MPA management materials that are currently available to practitioners (see Chapter Six for a list of some of these).

Principle Five: *Holistic*

- The guidebook assumes that a multidisciplinary approach to measuring MPA management effectiveness is most appropriate and useful. This holistic approach includes the use of both natural (e.g., ecological, population biology, environmental) and social (e.g., economic, cultural, governance) indicators.
- There is more to MPA management than simply conservation biology. This guidebook recognizes how the social sciences can be an important and useful complement to the biological sciences in measuring and improving MPA use.
- The aim of this is to allow practitioners to consider and evaluate multiple elements of management effectiveness performance, not just a few specific ecological aspects.

This guidebook has been structured logically around a set of steps and decision points in undertaking an evaluation of MPA management effectiveness using the indicators provided. These steps have been organized into four stages, or parts, of the overall evaluation process that the reader will undertake using this guidebook:

- Part 1: Selecting the appropriate set of indicators to measure.
- Part 2: Planning for how to evaluate the indicators selected.
- Part 3: Implementing the evaluation and collecting and analyzing data.
- Part 4: Sharing and adapting to the results generated.

Each of these four parts in the evaluation process – including the individual steps and decision points – are illustrated in a flowchart (Figure 2) to allow the reader to easily follow the content outlined within this guidebook. The guidebook chapters have been organized around the step-by-step process illustrated in the flowchart. As the reader works her/his way through the guidebook, so too will she/her work through the steps outlined in the flowchart. At the start of each chapter, the reader's position in the flow chart is revisited (illustratively) in order to provide some 'bearing' as to which part of the evaluation process the chapter focuses on and what steps will be covered. In this sense, the flowchart illustrates where the reader is headed, chapter-by-chapter, in following this guidebook. Therefore, in working sequentially chapter-by-chapter through this guidebook, the reader will be undertaking the step-by-step process through all four parts of the evaluation. This is the process that the reader is recommended to follow in using this document.

The following is a brief description of which part of the evaluation process is covered within each chapter:

- This chapter (Chapter One) is an introduction, providing an overview on why MPAs must be evaluated, the purpose of this guidebook, and how it should be used.
- Chapter Two discusses how to select relevant indicators (Part 1), as well as how to assess one's ability to collect them and then how to prepare a plan to undertake the MPA evaluation (Part 2).
- Chapter Three is the "heart" of the guidebook. It introduces three indicator categories MPA practitioners can use to evaluate the efficacy of their management actions and describes the implementation of the evaluation and collecting and analyzing the data (Part 3). This Chapter is closely linked to Appendix One, which contains each of the 44 indicators with an explanation of how to measure each indicator.
- Chapter Four describes what practitioners can do with the results of their analysis. This includes both an overview on both how to communicate and share results with various audiences and how to learn from these results by adaptively improving management efforts (Part 4).
- Chapter Five introduces how to move beyond the guidebook by linking up with other MPA sites that are also evaluating themselves. Whether through the MEI network or

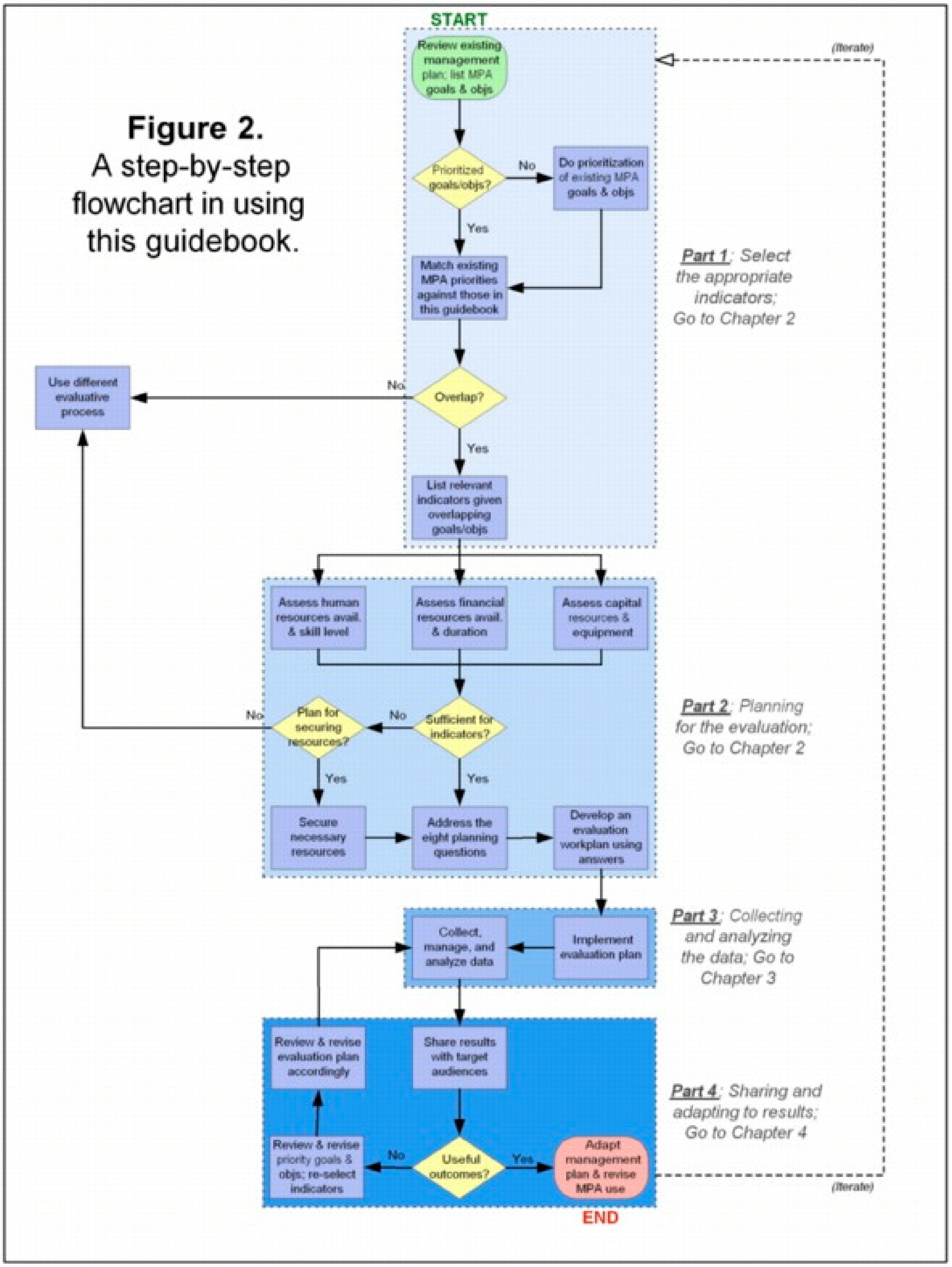


Figure 2.
A step-by-step flowchart in using this guidebook.

other similar initiatives, this section was written encourage the reader to share results more broadly and benefit by learning about and building on other's findings and adaptation.

Following Chapter Five, there is a list of useful references, works cited, and a glossary of common terms used throughout the guidebook.

Finally, four appendices are included in the guidebook:

- Appendix One includes full descriptions on each of the 44 indicators and how to measure them.

- Appendix Two presents a summary of the pilot sites that tested this guidebook (all 4 Parts) at their MPAs and that provided examples to the guidebook.

- Appendix Three contains a methodological primer on sampling, data collection, and analysis to be of assistance to readers in their consideration of how to plan for (Part 2) and collect (Part 3) the indicators.

- Appendix Four contains the set of generic MPA goals, objectives, and indicators.

- Appendix Five a few in-depth case studies of pilot sites that carried out a test evaluation using this guidebook that helped to refine it.

Note that to work through this guidebook, part-by-part and step-by-step, will take a notable commitment of time as well as organizing the human and financial resources in order to complete what is outlined. For this reason, the reader is recommended to carefully read through Chapters 1 and 2 and become at least loosely familiarized with the indicators and steps outlined in Chapters 3 and 4 before attempting to organize the necessary human and financial resources to undertake an evaluation of a MPA. In fact, this planning part of the evaluation process (Part 2) will not become relevant until the reader has first read through the guidebook as a whole and carefully completed the steps included under Part 1 in Chapter 2.

1.5 Assumptions Made About the Reader

The primary audience for this guidebook is MPA managers and practitioners. However, it is also intended to be useful to other non-MPA conservation practitioners and audiences, including decision-makers and government agencies, non-governmental organizations, donors, and students. The guidebook provides methods for evaluation that can hopefully be used by those with diverse experiences and backgrounds:

- People who are working in, fishing near, and living close by a MPA.

- People who work in city offices in agencies and organizations that implement MPAs.

- People who serve as donors and decision makers in various countries supporting the use and proliferation of MPAs.

- Researchers, students, or citizens who are interested in learning how a MPA they support is doing or merely have an interest in learning how to effectively use MPAs.

The methods presented in this guidebook are oriented to practitioners who have a fundamental understanding of scientific inquiry and have achieved an educational or experiential equivalent level to that of a college degree in the natural or social sciences or related environmental or natural resource management studies. To become more familiar with or brush up on the fundamentals of the biological and social sciences and environmental management before using this guide, a few useful references are available for this purpose and are referenced in Chapter Six.

It is also assumed that prior to commencing the process outlined in this guidebook, the specific goals and objectives of the MPA being evaluated are known to the reader (as an evaluator) and are adequately articulated (see Box).

1.6 How this Guidebook Was Developed

In 2000, IUCN's WCPA-Marine Theme and the World Wide Fund for Nature (WWF) launched a partnership to develop the MPA Management Effectiveness Initiative (MEI), in the process creating a core team to implement the initiative. This Initiative builds on the progress of the WCPA Management Effectiveness Task Force and addresses the unique characteristics of MPAs by developing a set of MPA-specific management effectiveness indicators that can be used globally. This publication is a product of the MEI, aimed at guiding the reader in how to use a set of management effectiveness indicators that are specific to MPA evaluation.

The development of this guidebook occurred over a three-year period (2001 through 2003). A core team was formed in under the MEI partnership in early 2001 to lead the investigation into improving MPA Management Effectiveness. An important component of this investigation was the production of sound guidance for MPAs operating anywhere in the world on how to assess and improve their own management effectiveness. This led the core team to begin the development of identifying a set of indicators that could be used by MPAs for this purpose, including instructions on how to use the indicators. The result was a process during which the creation, testing, review, and refinement of this guidebook and the 44 indicators presented herein were generated.

Since MPAs are established for many reasons all over the world, the guidebook was developed to reflect the diversity of potential goals and objectives of why MPAs are implemented globally. Accordingly, the foundation of this guidebook is a matrix of overlapping MPA goals, objectives, and management effectiveness indicators (see Chapter Three). It is from this matrix that guidance can be provided to MPA practitioners to allow them prioritize/select and use the relevant indicators that best reflect the goals and objectives of their MPA.

This guidebook and the 44 management effectiveness indicators reflect:

- More than two years of development, field testing, and revision.
- The contributions and reviews of XX internationally recognized MPA experts from XX countries.

Box X. The Goals and Objectives of a MPA

A protected area is one example of a conservation strategy that can be used to manage natural resources. When a decision is made to use a MPA strategy, one of the first steps taken is to design an appropriate management plan for the strategy (see Salm and Clark 2000, Kentchington year). A management plan documents an explicit set of goals, objectives, and activities that will be undertaken over a specified period of time and area, and articulates how the conservation strategy being used is designed specifically to address the threats present (see Margoluis and Salafsky 1998 for more details). While not all MPAs require a complete management plan to begin operation, eventually a comprehensive and representative plan will be needed to strategically guide the area's long-term aims and development (Salm and Clark 2000).

The foundation of any management plan is the specific set of goals and objectives to be achieved by the MPA. The strategy of action, workplan of activities, and timeline typically reflect the specific goals and objectives of a MPA. Further, the values held by a society are often reflected in how the goals and objectives of a MPA are articulated.

A goal is a broad statement of what the MPA is ultimately trying to achieve. A useful goal is one that: (a) briefly and clearly defines the desired long-term vision and/or condition that will arise from successful use of the MPA, (b) is typically phrased in relatively general, comprehensive prose, (c) is simple to understand and communicate, and (d) is largely measurable.

An objective is a more specific statement of exactly what must be accomplished in order to attain a related goal. An objective can be thought of as more of a limited-term, measurable step necessary to complete toward reaching a stated goal. In this sense, attaining a goal is typically associated with the achievement of two or more specific, corresponding objectives. A useful objective (Margoluis and Salafsky 1998) is one that meets the following criteria: (a) it is specific and easily understood, (b) it is written in terms of what will be accomplished, not how to go about it, (c) it is realistically achievable, (d) it has been defined within a limited time period, and (e) it's achievement can be concretely measured and validated.

Goals and objectives are often developed in a participatory manner so as to appropriately reflect the needs and desires of all stakeholders involved with the management of the MPA and use of surrounding marine resources.

Poorly designed and/or articulated goals and objectives can be a serious problem for MPA managers. Likewise, a set of goals and objectives that have been appropriately developed and are useful for management purposes (as defined by the criteria listed above) will improve the likelihood of the MPA being effectively managed.

[@@@ Insert example of a good and bad set of goals and objectives?]

Readers who would like to use this guidebook to evaluate a particular MPA are advised to first confirm that:

- A set of goals and objectives specific to the MPA being evaluated exists.
- A complete copy of the specific set of MPA goals and objectives is in the possession of the reader. If the reader has not yet accessed the set, they make start by reading the MPA management plan, which often lists the set of goals and objectives since the activities outlined to be undertaken within the plan are (or should be) correlated directly and logically to attaining a set of specific goals and objectives.
- The set of goals and objectives has been adequately defined so that they are clearly and properly articulated within the overall MPA management strategy. Where necessary, the reader is strongly encouraged to first seek a more clear and useful articulation of the specific set of MPA goals and objectives with the relevant parties *prior* to commencing any steps of the process outlined in this book. A few useful references in going about revisiting goals and objectives include *insert citations*.

It should also be noted that in completing an evaluation using this guidebook, one important output the reader should keep in mind is the strengthening and revision of the existing set of MPA goals and objectives so that they become more clearly defined, precise (measurable), and useful for future management purposes.

- The testing of the indicators at XX MPA sites in XX countries.
- The participation of many hundreds of people living in or near these MPAs.

A summary history of the steps and timeline in how the indicators were developed and tested from 2001 through 2003 is presented in Chapter Three.

1.7 Introducing the Pilot MPA Sites

[@@@ Insert a brief introduction to the pilot MPA sites chosen as examples for the guidebook once designated and testing completed; include global locator map of where sites are.]

To ensure that this guidebook and the indicators are applicable, easy to use and flexible to a range of different types of MPAs, the Working Draft Guidebook was field-tested in pilot projects at XX MPAs. A range of sites was selected in order to apply the tool to diverse situations and assure the usefulness in a broad spectrum of circumstances. Each pilot site addressed unique issues and involved different perspectives. The sites were chosen through a selection process:

1) Sites had to meet multiple criteria to participate, including, the commitment of the site manager to undertake an effectiveness evaluation, site capacity to conduct the evaluation, availability of qualified staff to be trained, and adequate institutional framework and authorities administering the site; and

2) The suite of sites had to represent a diversity of the following site characteristics; management objectives, institutional arrangement, latitude, size and geography.

A workshop was held at the beginning of the pilot projects for to train site representatives in implementing the Working Draft Guidebook and to develop evaluations plans for the projects. Through these pilot projects the MPA community can learn from applying the guidebook and conducting assessments in a variety of ecosystems and management strategies.

The pilot sites have graciously agreed to share their results and experiences from using a working draft of this Guidebook between October 2002 and March 2003 to test out and refine the indicators contained herein. The actual data and results taken from the pilot projects are used to illustrate what indicator data and results could look like at a MPA site as well as provide the reader with a more concrete, real-world context. The pilot sites' experiences in testing and using the indicators are also shared with the reader in Appendix Two, along with a brief summary of the location, history, and operating conditions at the site.

CHAPTER TWO: Indicator Selection and Evaluation Planning

This Chapter is oriented around guiding the reader through the first two parts of the MPA management effectiveness evaluation process:

- Part One: Selecting the appropriate set of indicators to measure.
- Part Two: Planning for how to evaluate the indicators selected.

The steps entailed to complete both parts of the evaluation process are introduced in this Chapter, and are illustrated as flowcharts in Figures 3 and 4, respectively.

Part One: Selecting An Appropriate Set of Indicators

The starting point (see Figure 3) for this evaluation is with the goals and objectives upon which your MPA was declared and which have already been documented and developed in the existing management plan and other relevant documents. In this context, the goal is what the MPA is ultimately trying to achieve. The objective is the desired accomplishments or outcomes necessary for the MPA to attain in order to realize the goal(s).

But given your MPA's goals and objectives, how then are you to identify or select the 'right', or *most important*, evaluative indicators to provide those key pieces of information that will tell you whether or not you are achieving your specific goal and objectives. Going about this can be tricky. If indicators can be chosen specific to your MPA, rather than simply being assigned by an outsider, than a pragmatic and useful approach to measuring the performance of your MPA can be initiated at the outset.

As mentioned previously, there are 44 total indicators in this guidebook: 11 biophysical indicators, 17 socioeconomic indicators, and 16 governance indicators. These were selected from a much larger original list of XXX potential indicators. In developing the set of 44 indicators, significant time, thought, field-testing, and revision has gone into developing this broad range of indictors to meet the possible range of goals and objectives of MPAs.

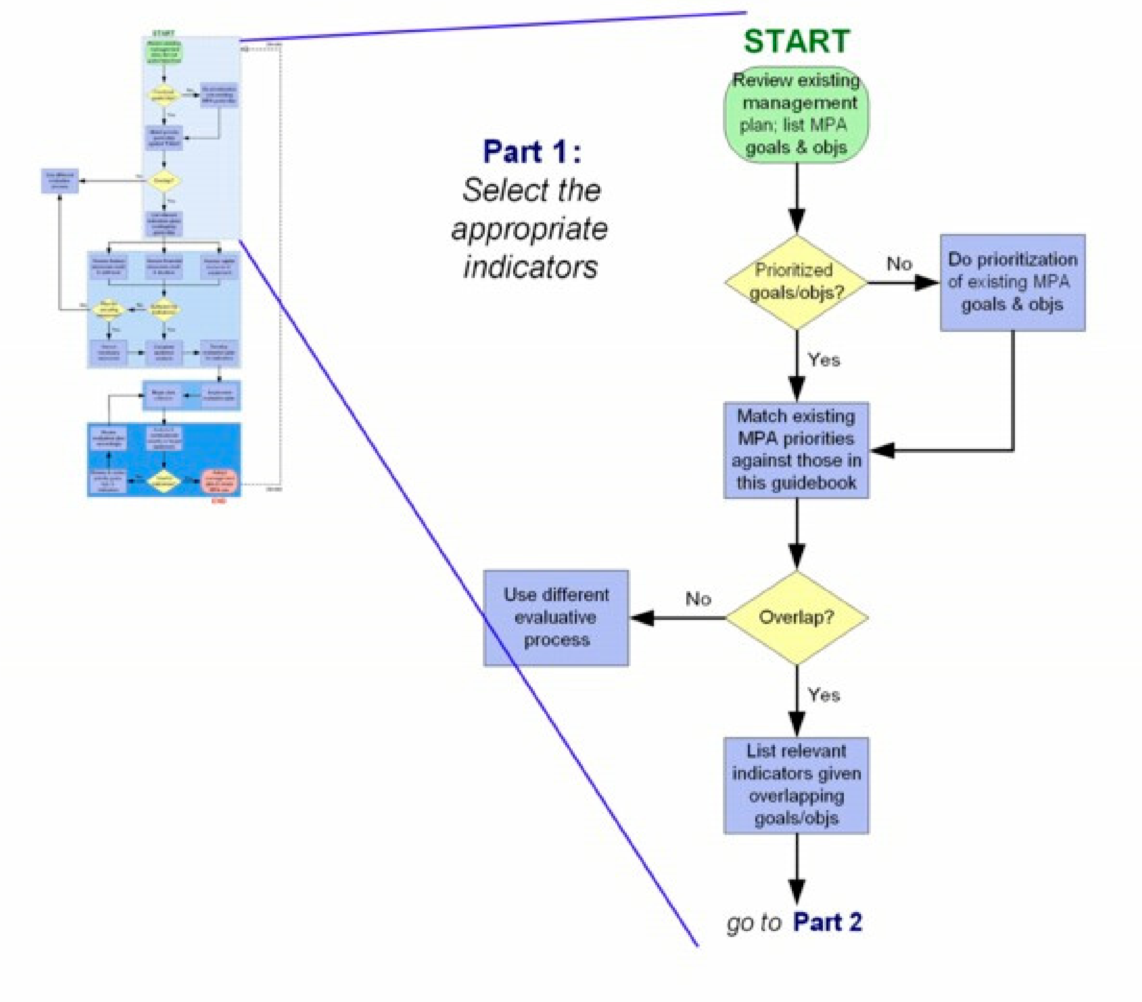
Not every one of the 44 indicators may be relevant to your MPA. Thus, it will be necessary to select an appropriate set of indicators for your MPA. The following steps are suggested to do this:

1. Locate the management plan and other relevant information (e.g., accompanying legislation or declarative documents) relating to the aims and purpose of your MPA. Review these documents and identify the goals and objectives.

2. On a sheet of paper, list out all of the goals and objectives related to your MPA.

3. Of the stated goals, identify which are of highest priority. If it is not clear which are of highest priority, then use a prioritization exercise to determine this (see Box 3 on two

Figure 3. The steps entailed in selecting an appropriate set of indicators to measure. These steps represent the first step of the overall evaluation process.



suggested methods of prioritization called "pairwise" and "criteria" ranking that might be useful to the team). Note that this prioritization should be undertaken with the needs of relevant stakeholder groups in mind. When you are finished with identifying the priority goals, list them out on a separate piece of paper along with their associated objectives.

In some cases, the MPA management plan will only include the most important (i.e., priority) goals and objectives in its declaration and maintenance. As such, they will be the priorities.

If you have one goal with many objectives, you may need to prioritize at the objectives level and list the most important out on a piece of paper.

Box 3. Prioritizing Your MPA's Goals and Objectives

If your MPA has so many goals and objectives that you are skeptical of your ability to evaluate them all given available resources, you can sort them by importance through prioritization exercises.

One useful and rapid prioritizing method is called pairwise ranking. Pairwise ranking is used to determine the main preferences of individuals, identify their ranking criteria, and easily compare the priorities of different individuals.

Pairwise ranking generally involves the following steps (adapted Margoluis and Salafsky 1998):

- Begin by identifying all of the goals (and/or associated objectives) to be prioritized.
- Then record each of these items on a separate index card with a pen.
- With the help of those involved in the ranking exercise, list out each possible pairing between any two of the goals/objectives in your set.
- Next, working down the list of possible pairings, place the first pairing (index cards) of goals or objectives in front of each respondent and ask her/him to choose the most important goal/objective between the two. Record the choice in a table (see illustration below). Ask the respondent to explain why s/he made the choice and record the response in a second table. Alternatively, a focus group can act as a single respondent if it is able to come to consensus on choices.
- After this, present and choose between the next pair of choices, recording the response and reasoning. Continue through the list until all possible combination of pairings have chosen with the respondent and the table of responses has been completed for the individual.
- Without the respondent looking on, quickly tabulate and score the overall preferences by counting (sum) the number of times each item was chosen over any other. Record these scores in the table and list out the most preferred (highest score) to least preferred (lowest score) goals/objectives based on the total score.
- Crosscheck the results by asking the respondent what s/he thinks is the most important preference out of all of the potential goal/objective choices.
- Repeat the exercise for the necessary number of respondents.
- Finally, tabulate total preference scores across all respondents to determine the group's overall preferences. List these overall preferences from highest to lowest and begin to discuss how to divide the ranked items into higher and lower priorities.

[@@@ Insert example pairwise ranking table and scores for objectives – from pilot site?]

A different but complementary prioritization tool is criteria ranking. This is a process during which the respondents score (typically on a 1-3 or 1-5 scale) each item individually against some set of defined criteria. For example, in the case of a management team prioritizing its 25 MPA objectives, it may choose to use a 1-3 (i.e., low, medium, high) scale for rating each of the objectives individually against the following four criteria: (a) degree of social importance, (b) degree of biological importance, (c) urgency of need, and (d) relevance given current events. In a table where the 25 objectives are listed randomly as rows and the four criteria are listed as the four fields (columns), the team could individually or as a group rank each objective separately against each of the four criteria. When all 25 objectives have been ranked, the four scores for each objective could be summed and then the objectives could be prioritized based on their comparison of those from the highest total scores (3+3+3+3 = 12) to lowest (1+1+1+1 = 4). Averaging total scores across individuals within a team can provide a group's prioritization.

This selection process can become more complex than necessary. In most cases it should be fairly intuitive or even obvious and simple to identify the most appropriate indicators given one's prioritized goals and objectives.

4. Locate the three summary tables of biophysical, socioeconomic, and governance goals and objectives provided in Chapter Three (see pages XX - XX).

5. Identify the similar or overlapping goals (and associated objectives) between your MPA and what is listed in this guidebook's three summary tables of goals and objectives. List out on yet another piece of paper the overlapping goals and objectives using the numbers and names of them in the summary tables.

6. Cross reference this list with the summary indicator tables in Appendix One (see pages XX - XX) in order to identify which specific indicators to measure.

7. Make a list of these selected indicators by their three categories.

If you find (in your judgment given known resources and constraints) that too many indicators have been selected, you can always go back and reprioritize goals and objectives to reduce the number of corresponding indicators. This can be repeated until you have a workable number of indicators.

Based on the priority goals and objectives for your MPA, think about what type or types of data you assume you would need to collect to evaluate each goal and objective. From this, how do the three sets of indicators you have selected as the most appropriate to measure compare to your assumptions of what data are needed? Do your assumptions agree with the indicators, or are there information needs missing?

A final note. It is recommended that if your MPA's priority goals and objectives span biological, social, and legal needs, you should be sure to include the most appropriate indicators from all three categories of indicators in order to fully diagnose whether or not your MPA is truly effective in meeting these needs.

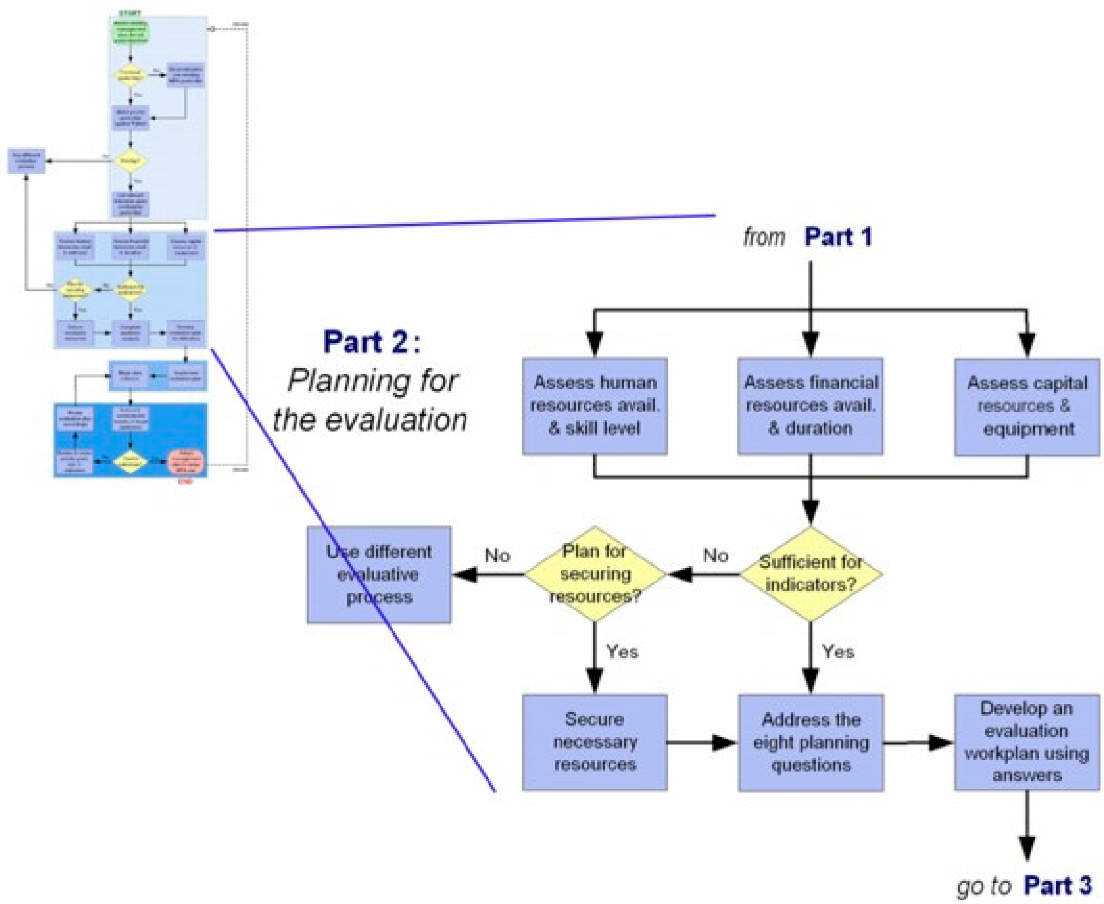
Part Two: Planning for How to Evaluate the Indicators Selected

As illustrated in Figure 4, the second part of the evaluation process involves two sets of steps regarding: (1) assessing relevant resource needs to do the evaluation, and (2) addressing a set of eight questions in developing an evaluation workplan. Each of these steps are described here.

Step 2-1 Assess relevant resource needs to do the evaluation

The objective of an MPA evaluation is to improve management effectiveness of the MPA. The findings of the evaluation can be used in adaptive management; to influence policy to improve MPA systems and management arrangements; and to provide accountability to, and raise awareness of, civil society (Hockings et al. 2000). To do this will require careful thought and planning. Thus a critical step in the overall evaluation process is to develop a thoughtful and realistic evaluation workplan outlining all the

Figure 4. The steps entailed in planning for the MPA evaluation. These steps represent the second step of the overall evaluation process.



details necessary to actually undertake data collection of the indicators that have been selected. However, before an evaluation plan is undertaken, it is first very important to determine generally whether or not it is realistically feasible to collect data for the indicators selected given the human, financial, and time resources that will be required.

This section outlines a process to help the reader identify whether or not the necessary resources are available to measure the selected indicators. If the reader determines that she/he does not have the necessary resources on hand, this section discusses how to think about proceeding in securing them.

There is no simple way of identifying all of the necessary resources that will be required to measure the selected indicators from Part One. Indeed, the scope of necessary resources will depend on how many and which indicators have been selected. Further, the availability of these resources for an evaluation will be specific to each MPA site based on its status and level of support.

An estimate of these needs can be made by the evaluation team based on addressing the following questions for each indicator selected:

- What are the estimated *human resource needs* to measure and analyze the selected indicators? For example, how many people will data collection require for each indicator? How large of an area/population needs to be sampled? How much of peoples' *time* will be invested in measurement and analysis activities? What level of skills and training are necessary? Do the people who would be part of the evaluation team have these skills? Will outside technical assistance be required?

- In addition to people and their time, what *capital investment needs* are there to undertake the selected indicators? For example, what equipment (such as SCUBA gear or hand-held GPS units) and transportation (boats, a truck) are required to measure the selected indicators? What types of analytical investments (e.g., database and statistical software programs, or GIS equipment) must be made in order to generate and use results? What types of infrastructure (such as electricity to run computers) are needed on site where the evaluation team will be working?

- Based on the answers to the estimated human resource and capital investment needs, how many estimated *financial resources* will all of these cost? What does the evaluators' time cost? How much are consultants and training costs? What equipment and other capital costs must be purchased?

To assist you in addressing these important questions and estimating resource needs, each indicator description (see Appendix One) contains a summary of the likely human and equipment resources that will be needed to undertake the indicator's measurement. In some cases, the indicator is highly technical and requires large resource needs that may make the indicator difficult to undertake at some MPAs. Where possible, low-tech and low-cost alternatives to measure the indicator are also provided in the description.

Once estimates on assessing the human, capital investment, and financial resource needs have been generated for the indicators selected, you can begin to assess whether or not the human and financial means are available at your disposal to realistically undertake the evaluation. Will the evaluation have access to the necessary estimated resources? If so, you can move on to the next step. If not, is there a plan of action to secure these resources? Assuming that there is a plan to do this, this must be successfully undertaken and the necessary estimated resources secured before moving on with the evaluation planning.

Assuming that you both neither have the resources necessary to evaluate the selected indicators nor a plan to secure them, the process outlined in this guidebook is likely not for you. Instead, there may be other ways for you to undertake a no- or low-cost evaluation that do not require data collection across specific indicators. Some alternative evaluation techniques that may be of interest in this case are listed in Chapter Six. Determining the most practical indicators must be based on the site's needs, resources, and capabilities. If in selecting the important indicators, it is determined that the necessary human and financial resources or capacity are not in place to realistically undertake them, ask for help from the MEI and contact other people and teams involved in the MPA management effectiveness network that are doing similar work (see Chapter Five).

Box 4. Some Things to Consider When Developing an Evaluation Workplan

- **The Scale of the Evaluation**

This guidebook is focused primarily on site level evaluations, that is, the MPA site and the immediate surrounding area or community. We are concerned with evaluating the impact of the MPA on the natural and human ecosystem in the immediate area of the MPA, but also understanding how these impacts compare with adjacent areas that are not protected.

- **Minimum Requirements for Doing the Evaluation**

Several minimum requirements of the MPA are necessary before the management effectiveness evaluation is conducted. First and foremost, there should be a published management plan that includes the goals, objectives and activities for the MPA. It is difficult to evaluate management effectiveness unless there is a base from which to conduct the evaluation; that is, the goals and objectives. There may be cases when an MPA does not have a full, reviewed management plan in place, at a minimum, the site should have clearly stated goals and objectives to conduct an evaluation. Second, baseline data using the indicators are collected at the beginning (pre-establishment) of the MPA. These data provide a benchmark against which change that occurs over time can be assessed. The MPA should be in operation for a period of time before the first management effectiveness evaluation is conducted. It is suggested that the MPA be in operation for at least two years so that management activities have started and have begun to have an effect. If a site does not have a management plan, it is still possible to conduct an effectiveness evaluation if at a minimum stated goals and objectives of the MPA are available.

Step 2-2 Develop an Evaluation Workplan

Assuming the human, financial, and equipment resources necessary to collect data on the indicators selected are confirmed available and earmarked for the evaluation, the next step in this part of the overall process is to develop a workplan for the evaluation itself. Note that it is very important that the reader first estimate and confirm that the necessary resources to measure the indicators are available before spending the time and energy necessary to develop an evaluation plan with the evaluation team and relevant stakeholders who will be involved in it.

Why is an evaluation workplan even necessary? Before implementing the evaluation of the indicators that have been selected, a thoughtful and realistic workplan for the details of evaluation must first be developed. An introduction to the steps required in this process is outlined below.

Conducting a thorough and useful MPA management effectiveness evaluation will require planning. It is therefore required that prior to undertaking any measurement of indicators, a workplan for the evaluation be developed. This evaluation workplan will provide a structure for collecting data related to the MPA goals and objectives in order to measure the impacts of the MPA activities. This type of evaluation (impact assessment) is critical because meeting the MPA's goals and objectives are ultimately what the MPA interventions and activities are all about.

A complete evaluation workplan should clearly and concisely answer eight questions:

1. **Why is the evaluation being done?**
2. **Who are the results for?**
3. **Who is going to be involved?**
4. **What indicators will be measured, and how?**
5. **What is needed to do this?**
6. **When will it be done?**
7. **What happens to data after they are collected?**
8. **What happens to results after they are generated?**

Each of these questions and how to go about answering them are described below.

Question One: Why Is the Evaluation Being Done?
A management effectiveness evaluation can be conducted for a number of reasons. It may have been requested by someone external (donor, decision-maker, government agency, international NGO) to the MPA to be used to determine, for example, how the MPA is performing or to compare it to other MPAs. It could also have been requested internally (MPA management, advisory board, resource user group) to the MPA in order to evaluate how well goals and objectives are being achieved. In either case, it is important to report on the context of how the decision was made to conduct the evaluation so that it is transparent and can be used to guide the evaluation.

Question Two: Who Are the Results For?
A common contributor to ineffective communications is insufficient thought about exactly to whom results should be directed, for what reasons, and how. MPA practitioners need to think very carefully about the audience(s) that they are interested in reaching and then develop a plan for communications and reporting of results once an evaluation is completed. In thinking about this, MPA practitioners may find that there are a number of important target audiences.

In some cases, it may be that whoever requested the evaluation will also the primary – or perhaps only – audience with whom results are to be shared with. But more often than not, this is not the case. Typically there are several interested parties in the results of an evaluation, at various levels in different sectors of society. Even if it is the case where one audience is requesting the evaluation and results, it may be that there are others who would find the results useful and that in providing them with findings could bring benefits to the management efforts.

A simple and useful tool to guide MPA practitioners in thinking on who might be interested in the evaluation results is an audience analysis matrix (McCann and Parks 2002). An audience analysis matrix logically structures a practitioner's responses to a set of questions in a way that can then assist in creating a communications plan.

Questions that are raised through an audience analysis matrix include:

- Who are the potential audiences that may benefit from or be interested in your communication of evaluation results?

- Which of these audiences are internal stakeholders in the MPA management? Which of these audiences are external to the MPA management?

- For each audience, what level of influence and interest do they have over the MPA and its performance? How important is it for you to stay in communications with each audience and how high is the need for you to keep them informed of the effectiveness of the MPA?

- For each audience, what do we know about their preferred method of receiving information? This may be closely related to their technological capacity. For example, do they prefer to read information or listen to a radio or television? Are they computer literate and use the Internet regularly? Do they gather together periodically at meetings or conferences? If so, when are these forthcoming?

- What language is used by each audience? What is their average educational level? Do they prefer technical or academic prose to that of a more causal, conversational style? Where and how are spoken communications typically done?

- What is it that you specifically expect each audience to do with the results and information you present to them? What actions do you want them to take following the delivery of your results? How are these expectations linked to the goals and objectives of the MPA you are working with?

As responses to these and other questions are provided by the team, the responses should be entered in the appropriate location in the audience analysis matrix.

Review of the completed matrix by the practitioner team will allow for the prioritization of a set of target, or primary, audiences. This prioritization is largely based on the level of perceived need to reach such audiences and the extent and type of actions that such audiences can take. From here, the practitioner team can identify common and differing aspects (e.g., their preferred method of receiving information, the actions that can be taken by them) between target audiences and group them together or separate them apart accordingly. Providing a brief summary description for each target audience or group of audiences and their characteristics can easily flow out of the matrix. A sample matrix from the xxxxxxxx example MPA site can be found in Figure X.

[@@@ Figure X and name of sample site to be inserted.]

Audiences vary widely by MPA site and type. Commonly identified audiences (that could be either internal or external audiences, depending on the site) include:

- Advocacy groups
- Coastal communities/residents
- Decision makers (policy) and elected officials
- Donors
- Educators (elementary through college levels) and the academic community
- General public
- Government agencies and bodies
- Indigenous peoples
- Journalists
- Marine resource user groups
- Non-government (national, international) organizations
- Other MPA managers and practitioners
- Project managers and staff associated with the MPA

Box 5. Why Think About Communications at the Outset?

For many marine conservation practitioners, communications and reporting of results is not something that is given a substantive level of consideration or thought. Practitioners are often so busy implementing, maintaining, and monitoring the MPA that communications of what is learned may not go far beyond a report to a donor or the government and perhaps a contributed paper given at a conference or published as a journal article. At the same time, it is likely that if any MPA manager with a few years experience is asked how important clear and consistent communications with stakeholder groups is to the success of management efforts, they are likely to respond "very important."

The right time to begin thinking about and planning for communications is at the outset of the MPA evaluation project, not the end of it. The rationale for this is twofold:

First, as the purpose of the MPA evaluation is to learn about the level of management effectiveness so as to improve or maintain it, this will inevitably require communicating the results of the evaluation with others who will influence this improvement or maintenance. In other words, it is important for practitioners to know at the outset of the evaluation who they will be sharing results with and why.

Secondly, if practitioners understand which target audiences they will de directing evaluation results to and why, then the evaluation process itself and the results that arise out from it can be oriented in such a way as to inherently and efficiently generate the relevant stories and findings for the previously-identified target audiences. This orientation will thereby allow practitioners to focus their application of results toward the most relevant vehicles for MPA adaptation and improvement. In other words, developing a communications plan at the outset of the evaluation will make applying results easier and more strategic.

In understanding one's communications needs and directions at the outset of the evaluation, the necessary activities, time, and human and financial resources to meet these needs can be planned for and budgeted into the overall evaluation timeline. These needs should be clearly outlined within a communications plan to accompany and be implemented with the overall workplan of evaluation activities. The full components necessary in creating this communications plan are discussed in Chapter Four.

- Researchers and conservation scientists
- School students from the elementary through graduate education levels
- Traditional leaders
- User groups including fishing and recreational use

Question Three: Who Is Going to Be Involved?
Determining who should conduct the evaluation and what skills will be required will differ depending on the indicators selected and the resources available to a MPA. For example, a large MPA such as the Great Barrier Reef Park in Australia has different needs and resources than a small 30 ha MPA in the Philippines. Should the evaluation be conducted internally or by external evaluators? What parts of the evaluation should be conducted internally versus externally? What level of expertise is needed to conduct the evaluation?

These are critical questions for the MPA manager and the answers may come down to impartiality, skills, and knowledge. On the one hand, there are benefits in involving outsiders who will be impartial and bring freshness of vision. On the other hand, they may have only limited knowledge of the area and learning about the site is a real cost in time and money. The outside evaluators may only visit the area for a short time and may take the information, perspectives and skills gained in conducting the evaluation with them. External evaluators may be necessary when the required skill base is not available locally. For example, the MPA staff may be very skilled in biological methods but have limited or no skill in social science methodologies (Hockings et al. 2000).

External evaluators (consultants, academics, funding agency staff) commonly focus on questions relevant to external bodies (stakeholders, funding agencies) and tend to focus on accountability. Internal evaluators (managers, staff) commonly focus on issues of relevance to the management needs (i.e. efficiency and effectiveness) without really questioning the overall program. Involvement of staff responsible for management of an area will generally greatly enhance the subsequent application of evaluation results in future work. On the other hand, an evaluation conducted entirely by insiders may lack credibility, especially if there is some controversy surrounding management of the area. Local stakeholder participation can address this issue and provide opportunities for developing stronger relationships between MPA staff and local people (Hockings et al. 2000).Local people are usually more sensitive to cultural complexities and have a more natural rapport with the people living in the area. Training local people to be evaluation team members builds capacity and increases the chances that evaluation will continue over time. However, using local people can also create problems as it may be difficult for them to ask certain questions of their neighbors. They may also be less objective than outsiders because they may believe that they know the 'right answers'.

If the evaluation is conducted internally, it is important to determine who on the team is responsible for what tasks, and for 1) directly collecting data and 2) overseeing data collection. In assigning tasks it is important to make sure that team members have the necessary qualifications and training to undertake the tasks. Also, that the workload for any one individual is not too heavy.

At its simplest level, an effectiveness evaluation could be conducted by a biologist and a social scientist. A more complete evaluation will require additional people with a diverse set of disciplinary skills. This will include marine biologists, ecologists, oceanography, economics, sociology, anthropology, law and political science. Very few, if any, MPA's have the full range of disciplinary skills on staff.

Ideally, the evaluation process should involve partnerships between a range of evaluators and stakeholders. Partnering with other institutions (outsiders), either locally or from afar, may be necessary. A local or foreign university, for example, may have staff that are interested in getting involved in an evaluation and doing it over the long term. These individuals or institutions may often participate for free or for a small fee. They could also be useful for transferring skills to the MPA staff who would then be able to carry on the activities themselves.

It is important to note that there are benefits and limitations with both external and internal evaluators. Table 1 summarizes some aspects to consider when deciding who should be involved in the evaluation.

Table 1. Aspects of who (internal versus external) should be involved in the evaluation.

Internal Evaluators	*External Evaluators*
▪ May have a bias to or complex relationships with a community	▪ Often provide impartiality, a fresh perspective, and credibility
▪ Have an understanding of the history, experiences, and details of the site	▪ May have limited local knowledge, learning is a cost in time and money
▪ Often live in or near the site	▪ Usually stay for short visits to the site
▪ Tend to focus on issues of relevance to the managers (efficiency and effectiveness of work)	▪ Tend to focus on questions relevant to external groups (stakeholders, funding agencies)
▪ May not have the skill base and need technical assistance	▪ Add technical expertise and perspectives from other sites
▪ Are able to enhance the application of results and future work	▪ Take away valuable information, knowledge, perspectives and skills

A range of skills from different disciplines will be required to obtain data on the biophysical, socio-economic and governance indicators. This will include marine biologists, ecologists, oceanography, economics, sociology, anthropology, law and political science. A simple effectiveness evaluation could be conducted with two people, a biologist and a social scientist. A more complete evaluation will require more people and more disciplinary skills. Very few, if any, MPAs have the full range of disciplinary skills on staff. Partnering with other institutions, either locally or from afar, may be necessary. A local or foreign university, for example, may have staff that are interested in getting involved in an evaluation and doing it over the long term. These individuals or institutions may often participate for free or for a small fee. They could also be useful for transferring skills to the MPA staff that would then be able to carry on the activities themselves.

If the evaluation is conducted internally, it is important to determine who on the team is responsible for what tasks, such as those who will collect the data and those who will oversee the data collection. In assigning tasks it is important to make sure that team members have the necessary qualifications and training to undertake the tasks.

Site level evaluations should generally aim to be participatory at all stages of the process and should include a wide range of stakeholders if a full overview of issues is to be achieved. Managers, local people and other stakeholders may have very different perspectives on these issues. Not only is stakeholder input important in the evaluation process, but also stakeholder involvement in the actual data collection and analysis. The importance of stakeholder involvement in the design of the evaluation is crucial as they may be interested in different questions than government, managers or scientists. It is often those who live and depend on the marine environment that need most to be heard and integrated into the management process in order to influence and change their behavior in ways that increase the effectiveness of protective actions taken. A number of participatory research methods are available for stakeholder participation.

Local stakeholder participation can provide opportunities for developing stronger relationships between MPA staff and local people (Hockings et al. 2000). Local people are usually more sensitive to cultural complexities and have a more natural rapport with the people living in the area. Training local people to be evaluation team members builds capacity and increases the chances that evaluation will continue over time. However, using local people can also create challenges, such as it may be difficult for them to ask certain questions of their neighbors. They may also be less objective than outsiders because they may believe that they know the 'right answers'.

Ideally if public participation can be adequately integrated together with MPA management, then those who are implementing and overseeing the MPA itself can strategically include those whom are most dependent on the marine environment and resources therein.

***Question Four:* What Indicators Will Be Measured, and How?**
Before selecting your indicators, skim briefly through Chapter 3, where a discussion is presented on using the indicators, and then to Appendix One where each of the 44 indicators and how to measure them are introduced. This will allow you to become more familiar with the indicators overall, as well as being better informed on those which you have selected and how you will measure them.

List your selected indicators and the methods used to measure them within the evaluation workplan.

***Question Five:* What Is Needed To Do This?**
The answer to this question will be very site specific, depending largely on what indicators are used, staff skills, need for outside assistance, size of the area, and other factors. Because resources are limited, some MPA staff may question spending funds on this activity. However, evaluation provides the means to better manage and measure impacts of the MPA and determine where to allocate resources in the future more efficiently. At least some financial, technical and human resources should be devoted to data collection and analysis. Items that may need to be included in the evaluation budget are staff salaries, field expenses, transportation, training, equipment, materials, and non-staff evaluator's fees and team meetings.

Earlier in this chapter you were guided through a process on how to estimate the resources needed to measure the indicators. The results from that activity (i.e., the estimated costs of staff needs, time, equipment, etc. to undertake the indicators selected) should address this question and be inserted into the workplan.

***Question Six:* When Will It Be Done?**
A timeline should be determined for an evaluation, beginning with the planning stages, when data will be collected, analyzed and incorporated into improving or changing management actions. A timeline can also provide a means to set up targets and milestones to accomplish along the way. When creating a timeline there are several important considerations:

How much time is needed? It is difficult to say precisely how long it will take to conduct the evaluation. In addition, the methods used for each indicator differ, although a similar methodology, such as a survey, can be used for several indicators. The evaluation should not be a consuming task for the MPA staff, but it is an important activity and a minimum of 10 percent of staff time may be allocated to this task annually.

The timeline should consider the amount of data that needs to be collected and when that data needs to be collected. The amount of data depends on internal and external audiences' needs, as well as on the type of data being collected. To determine when data should be collected, it is especially important to consider seasonality. For example, fishing is very seasonal, as is the supply of fish for consumption and market needs. Data should be collected at the same time of year to ensure comparability over time. There may also be seasons when it is difficult to do household surveys in a given village because people are away or very busy.

The most commonly used methods involve collecting data on the same indicator over time. In these cases, at a minimum, baseline and final data needs to be collected for each indicator. In many cases, however, you may wish to collect data on a more frequent basis, such as once a year (Margoluis and Salafsky 1998). Information on the timing of data collection is addressed for specific indicators in Chapter 4.

Question Seven: What Happens to Data After They Are Collected?

The next item to address within the evaluation workplan is describing the process that data collected go through once the specific indicators have been measured. In other words, after an evaluator has collected all the necessary data, what happens with them? This process is commonly referred to as data management. This is a critical, and often overlooked, stage of the data collection and analysis process. There are several good resources regarding the subject of data management listed in Chapter Six. However, a brief overview of the aspects of data management are provided here.

There are four important questions that need to be answered within the evaluation plan in regard to data management. Each of these questions are briefly discussed below. The answers to these four questions should be clearly summarized within the evaluation workplan so that all who are involved understand exactly what is to happen with data once they have been collected for the selected indicators. In the event that the responses to these four questions are detailed and not easily summarized, a separate "data management" document with this information should be appended to the workplan and referenced within it accordingly.

(a) To whom should collected data be given?

This answer to first question identifies the specific person (the "data manager") who is to receive all data gathered for each indicator selected after the evaluators have completely finished collecting them. In some cases this may be the evaluation team leader, or perhaps the same person collecting the relevant information (e.g., the team's socioeconomist). In other cases this may be the appropriate person on the evaluation team or management staff responsible for receiving and handling information; for example, a data analyst or a computer specialist.

(b) How are collected data to be submitted to this person?

The next aspect is for evaluators to know how they are to submit the data collected to the "data manager". To answer this question, the reader must first understand what *type* of information are being collected. This will depend on the indicator being measured. In some cases, the collected data will be numerical (quantitative), such as a ranking score, the number of times an organism is observed, a table of numbers, or a total area (km^2). In other cases, the information collected will be textual (qualitative; e.g., a word, a few sentences, or a story) or graphical (e.g., a map, a photo). Regardless of what type of data, the evaluation workplan will need to state what *form* specific types of information are to be submitted to the data manager.

For example: all numerical data are may be given to the data manager in the form of a table that the data manager has provided to the evaluators prior to the measurement. Or total areas can be submitted along with the original maps from which the area was calculated. In the case of textual information; data may be submitted in the form of a cassette recording, or as an electronic transcript (written) of this recording. Or household survey responses could be provided to the data manager as the original hand-written responses taken down on the original data forms or as a stream of text on notepaper (this would also assume that the data manager has good handwriting recognition skills!).

The answers to this question are very important in that they allow both the person submitting data (evaluator) and the person receiving them (data manager) to clearly and commonly understand what *type* and in what *form* data are to be submitted. This will greatly improve the accuracy and efficiency of the evaluation.

(c) What happens with the data when this person receives them?

Once data are submitted to and collated and received by the data manager, the responsibility over the data collected becomes that of the data manager. Immediately upon receipt of submitted data, the data manager will need to go through the following process.

First, the data manger will need to collate and review through the data set submitted for completion and errors/accuracy – this is known as data cleaning. If errors (accuracy) or 'holes' (missing datum points) in the data set are found, they should be returned to the evaluator who submitted them along with questions in regard to clarifying these issues. In some cases, an incomplete data set will reflect an inability to collect a particular datum point and therefore will not be able to be filled after-the-fact. In other cases, an error or missing datum point will be able to be corrected if identified by the data manager and the evaluator given the opportunity to review it.

Once a submitted data set has received approval or been 'cleaned', the next step is for the data manager to code and enter the data into a database. Data coding is the process of translating each datum point into the specified form needed for analysis. This translation requires a code sheet where the meanings for data collected and their coded equivalent are available to the data manager. For example, two or three specific but different words collected as a response to an interview question may be coded (translated) as a single equivalent number; e.g., the responses "sometimes", "frequently", and "always" equal "1", whereas "never" equals "0". In other cases, the original datum point and the translated equivalent (code) may be exactly the same. For example, a numerical ranking or a single word choice from a respondent survey may be coded as the same ranking. As a general rule-of-thumb, collecting data should be done with data coding in mind so as to ease the data manager's translation needs and reduce data management time. The specific codes data should be in depend entirely on how the data are to be analyzed and used.

As each datum point is coded, it should also be entered. Data entry is the (often lengthy and tedious) process of moving cleaned, coded data into a permanent storage location from which data analysis and export can occur. This permanent storage location is known as a database. In the case of the evaluation described in this guidebook, a "MPA management effectiveness" database will need to be created to permanently store of all the collated, cleaned, and coded data following submission. How data are entered depends on what type of database is being used. In many cases the data manager will enter coded data into an electronic "MPA management effectiveness" database. For example, coded quantitative data may be entered electronically using a computer into an electronic spreadsheet or database program, whereas coded qualitative and graphic data are entered into an electronic word processing program. In other cases, databases may be a filing systems of folders and paper or even a box of index cards. Choosing the 'right' database depends largely on the resources, skills, and infrastructure available to the evaluation team (and data manager). However, it should be noted that an important benefit of electronic databases is that they can be easily duplicated (as a backup) and do not take up much physical space (other than a computer). What is most important is to use a database that is mostly likely to assure permanence and utility.

(d) How are the data made available for analysis and sharing?

The ultimate aim of data management is ease of retrieval. Stored, coded data are only as good as the ease with which they can be easily shared and used for analysis and communication. Therefore the evaluation plan should briefly discuss how data are to be retrieved once they have been successfully entered into the management effectiveness database. Part of this discussion must include the specific process through which someone can contact and request access to or receive stored information from the data manager and database. Another aspect of this answer must include who is and is not allowed access to the database, and what the responsibilities are of these people who have access. In some cases the data may be available to anyone, such as on the world wide web. In other cases the data may be only accessible by one or two evaluation team members. In any regard, the process and means for making data available to persons beyond the data manager must be considered before data collection begins and included within the evaluation plan.

Question Eight: What Happens to Results After They Are Generated?

The final item to address within the evaluation workplan is how results are to be used after they are generated. As Chapter Three introduces data analysis and Chapter Four introduces the steps involved with sharing results with target audiences and adaptive management, the details of this are not repeated here. However, the following considerations should be briefly addressed within this final piece of the evaluation plan:

- Analysis

The evaluation workplan should introduce which analyses (see relevant indicator in Appendix One) will be undertaken with the data gathered and by whom. This should include what form results from the completed analysis will take.

The plan should also discuss why specific analyses are being undertaken. This will relate to how a specific analysis correlates to answers (or approaches an answer on) a specific question or set of questions that the evaluation team has regarding the status of management effectiveness and the MPA's priority goals and objectives.

- Communications

The evaluation workplan should also include an overview on the main points and concepts stated within the team's communications plan (see Box X in Chapter Four on how to develop a communications plan). This description will include how the communications plan will be carried out, particularly in regard to who is the coordinator and the timeline for sharing results with target audiences. Known communications needs with important internal and external target audiences and a strategy as to how these needs will be met should also be referenced in the workplan. In some cases, appending the evaluation workplan with the communications plan may be useful to the evaluation team and others who will be referencing the workplan.

- Adaptive Management

Once outcomes and findings are shared with target audiences, their use of this information to adapt and improve the MPA will need to be monitored. This process and timeline should be briefly referenced in the evaluation workplan in order to remind the evaluation team of how all the component parts and timeline of the evaluation are designed to feed into the ultimate aim: adaptive management and improved MPA use and performance. This aim is discussed more in Chapter Four.

Finishing Up Step Two: Pulling the Answers Together into a Workplan

At the end of answering these eight questions, the responses to them should be pulled together into a single, concise summary document or table that contains fields for answers to all eight questions. This may require paraphrasing or bulleting text and adding appendices with further explanations. This document or table will become the workplan from which the evaluation team members will all understand why, how, when, and by whom the evaluation will proceed. Think of it as the common map that will allow the evaluation team to get to the destination – improved MPA use. An example workplan that was completed by one of the pilot sites follows below.

[@@@ Insert sample evaluation workplan from a pilot site]

It is important to note that it is extremely difficult to say precisely how long it will take to conduct the evaluation, how much it will cost and other factors as each MPA is different in terms of objective and size, the indicators used will be different, the resources available to conduct an evaluation, and the skills of the MPA staff will differ. That being said, here are some guidelines to follow in planning for the MPA management effectiveness evaluation.

Note also that Appendix Three presents a methodological primer, which addresses issues of sampling, data collection, data analysis, and reporting. This resource may be useful in terms of the evaluation team's thinking through the necessary planning for their evaluation.

CHAPTER THREE: Using the Indicators

This Chapter is oriented around guiding the reader through the most important part of the MPA management effectiveness evaluation process:

- Part Three: Implementing the evaluation and collecting and analyzing data.

The steps entailed to complete this part of the evaluation process is introduced in this Chapter, as illustrated in Figure 5.

Part Three: Implementing the evaluation, collecting & analyzing data

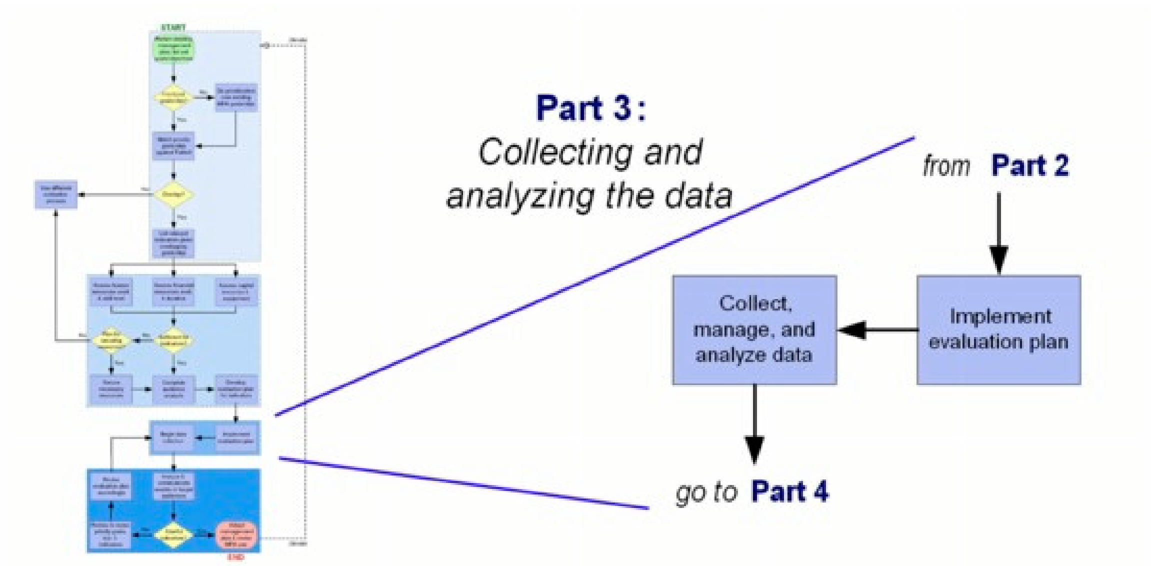
Part three involves two steps: (a) implementing your evaluation workplan, and (b) collecting, managing, and analyzing data related to your selected indicators.

Before these steps are discussed, it is first necessary to: (a) briefly introduce the 44 indicators contained in this guidebook, and (b) discuss how they relate to one another.

Introducing the 44 MPA Management Effectiveness Indicators

Indicators are an integral part of MPA evaluation. An indicator is a unit of information measured over time that will allow the evaluator to document changes in a specific attribute of an action or project. The results from the indicators are used to make changes in management plans and practices. These results are then fed into the MPA evaluation and used to adapt and improve the MPA, in other words, to measure or

Figure 5. The steps entailed in planning for the MPA evaluation. These steps represent the second step of the overall evaluation process.



demonstrate management effectiveness. The indicators in this guidebook are designed to allow managers and practitioners to regularly diagnose the status of their MPA.

Indicators can be used to promote learning, improve and share knowledge, and better understand successes and failures of an MPA. The results of an evaluation allow people to better understand how and why these changes are being undertaken in the management of a MPA. The indicators presented here will help you to learn more about your MPA and the people and resources that are impacted by it.

The indicators in this guidebook are largely oriented toward measuring outputs and outcomes of MPA use. Additional indicators that measure the context, planning, input, and process elements of management (see Section 1.2) should also be included in a comprehensive evaluation of MPA management effectiveness (see Hockings *et al.* 2000 for more information).

There are many attributes related to MPAs, such as bio-physical, socio-economic and governance, and it is not practical to measure all the potential indicators for these attributes. Therefore it is more efficient to use a limited number of indicators that represent the key aspects of the goals and objectives being measured.

The 44 indicators presented in this guidebook were developed and selected over a two-year process based on experts who reviewed, evaluated and prioritized them from a much larger set of indicators. The development of these indicators began with a survey of goals and objectives from MPAs around the world. This survey provided a list of the differing goals and objectives of MPAs that could be used to develop management effectiveness indicators. The goals and objectives fell into three different categories; biophysical, socioeconomic, and governance. Next, a literature review on existing indicators was conducted, not only for MPAs but also for protected areas in other resource systems (forestry, wildlife).

Based on this study, a draft set of generic MPA goals (XX), objectives (XX), and indicators (XX) were developed as matrices, linking specific indicators to specific objectives and goals in each of the three categories (biophysical, socioeconomic, and governance). These matrices were evaluated and revised based on a 4-month external peer review and a workshop of experts (see Appendix Four). This result was a revised set of 52 indicators, comprised of 18 biophysical, 19 socioeconomic, and 35 governance indicators. The prioritized indicators were then refined by the MPA MEI core team, including being subject to a second peer review.

This ultimately resulted in a final set of:

- 16 *goals*, comprising of 5 biophysical, 6 socioeconomic, and 5 governance goals;
- 65 *objectives*, comprising of 26 biophysical, 18 socioeconomic, and 21 governance objectives;
- 44 *indicators*, comprising of 11 biophysical, 17 socioeconomic, and 16 governance indicators. A summary of all 44 indicators by category is presented in Table 2.

A summary timeline and brief history of the specifics in how the 44 indicators and this guidebook were produced is included in Box 6.

Table 2. The 44 biophysical, socioeconomic, and governance indicators presented in this guidebook. See Appendix One for complete descriptions for each indicator listed.

Biophysical Indicators *(n=11)*	***Socioeconomic Indicators*** *(n = 17)*	***Governance Indicators*** *(n=16)*
1. Focal Species Abundance	1. Household perceptions of availability of local seafood	1. Existence of a management plan and adoption of plan
2. Focal Species Viability	2. Local fisher perceptions of catch	2. Understanding of MPA rules/ regulations by the community
3. Community Composition and Structure	3. Material style of life of households	3. Existence of a decision-making and management body with a relevant mandate to make decisions
4. Community Viability	4. Community infrastructure	4. Existence and compatibility of legislation with needs of the MPA management plan
5. Habitat Complexity and Integrity	5. Household occupational structure	5. Degree of stakeholder participation in management of the MPA
6. Food Web Integrity	6. Number and nature of markets	6. Level of satisfaction of stakeholders with participation
7. Water Quality	7. Availability of health services	7. The amount and quality of training provided to resource users to participate in MPA management
8. Return on Fishing Effort	8. & 9. Perceptions of non-market and non-use value of the MPA	8. The amount and quality of training provided to community org. to participate in MPA management
9. Area Restored	10. Percentage of particular group in leadership positions	9. Community organization formed and active
10. Area Under Reduced Human Use/Impacts	11. Local use patterns	10. Available human resources and equipment for surveillance and monitoring
11. Area Free from Extraction	12. Local attitudes and beliefs regarding the resources	11. Clearly defined enforcement procedures
	13. Changes in conditions of ancestral and historical sites/features/monuments	12. Number of patrols per time period
	14. Community knowledge of natural history	13. Effective education program on compliance for stakeholders
	15. Level of understanding of human impacts (including population) on resource	14. Regular meeting of MPA staff with stakeholders
	16. Distribution of scientific knowledge to community	15. Number of people trained in sustainable resource use
	17. Income distribution by source by household	16. Number of stakeholders involved in surveillance, monitoring, and enforcement

Box 6. A Brief History of How The Indicators Were Developed

April – August 2001

- *Activity*: Review study conducted of MPA goals and objectives from around the world.
- *Results*: XX goals and XX objectives identified for MPAs; organized within three general categories: biophysical, socioeconomic, and governance (see Table 1-1).

August – September 2001

- *Activity*: Research and identification of XX indicators linked to the MPA goals and objectives.
- *Results*: Draft matrices for the three categories of MPA goals, objectives, and indicators were created and then reviewed by international MPA experts around the world.

October 2001

- *Activity*: A workshop attended by 35 MPA experts from 17 countries was held in Venezuela to: (a) evaluate and refine the matrices, and (b) review, prioritize, and refine the indicators.
- *Results*: Consensus was reached on a revised set of corresponding MPA goals, objectives, and prioritized indicators (18 biophysical, 19 socioeconomic, and 35 governance), along with initial profiles for each indicator and their measurement (see Appendix Four for matrix results).

November 2001 – March 2002

- *Activity*: The indicators were refined and made operational by the core team of the MPA MEI.
- *Results*: Final matrices completed. The 44 indicators were made operational by developing definitions, methods of measurement, and providing guidance on analysis and use of results.

April – June 2002
- *Activity*: Core team and external peer review of draft indicators; creation of the guidebook.
- *Results*: The indicators were reviewed by the core team at a workshop in April, then by XX MPA experts around the world. A 150-page draft guidebook was completed by the authors.

July – August 2002
- *Activity*: Peer review (MPA experts and sites) of the draft guidebook and revised indicators.
- *Results*: A revised guidebook was completed based on peer review and pilot site feedback.

September 2002 – February 2003
- *Activity*: Pilot sites work with the core team to field test the revised guidebook and indicators.
- *Results*: *[to be determined…]*

March – May 2003
- *Activity*: A final guidebook with XX indicators is produced based on field-testing results.
- *Results*: *[to be determined…]*

[@@@ Insert the remainder of the timeline from here as it develops.]

Figures 6, 7, and 8 present the summary biophysical, socioeconomic, and governance MPA goals and objectives, respectively. Figures 9, 10, and 11 summarize the corresponding biophysical, socioeconomic, and governance indicators, respectively, and how they link to the relevant goals and objectives.

As you may have noticed in your selection of indicators, not every goal or objective has a corresponding indicator.

How the Indicators Relate: A Conceptual Model

A conceptual model is a diagram of a set of relationships between certain factors that are believed to impact or lead to a target, or the state, that is hoped to be positively influenced by the actions being undertaken (Margoluis and Salafsky 1998). Relationships in the conceptual model are represented by arrows. A conceptual model helps conservation practitioners think about how specific events, situations, attitudes, beliefs, or behaviors affect the target they are hoping to achieve.

For the purposes of this Initiative, a generic conceptual model has been developed for thinking about the factors (biological, socioeconomic, and governance) that influence MPA goals and objectives (target). This model is presented in Figure 12. In this conceptual model the target is represented by the goals and objectives of the MPA. The factors influencing the target are organized into three sets: socioeconomic, governance and biophysical. These three sets of factors influence each other, as indicated by the arrows. The governance factors influence the socioeconomic factors. Both the socioeconomic and governance factors influence the biophysical factors. The biophysical factors influence the natural state at the MPA. Therefore, all three sets of factors relate to the extent to which an MPA's goals and objectives (target) are achieved. The assumed causal relationships of factors in this model can be discussed individually.

For example, the model indicates that legislation may influence what types of livelihood activities are allowed in the area of the MPA. In turn, these operating livelihoods (of user groups) influence both the degree of fishing effort and the population size of particular target species present. The status of these species influences the degree to which a MPA's biophysical goals and objectives are met.

As another example, socioeconomic factors such as the community knowledge of natural history and number and nature of markets are directly related to use of the resource and influence biophysical indicators. Likewise, changes in biological factors such as community structure influence household occupational structure and enforcement procedures. Also, local attitudes and beliefs regarding the resource influence the degree of stakeholder participation in the management of the MPA.

The model not only illustrates the assumed relationships between the three categories (biophysical, socio-economic, and governance) of factors and how they generally relate to one another, but also which of the 44 indicators correspond to these factors sets and their relationships between one another. The linkages between factors and indicators are important, and should be considered when you are analyzing and interpreting results with individual indicators. This will strengthen the uses and application of the output of the indicator. Creating your own conceptual model may be useful tool in thinking about how specific factors (and indicators) are related to your MPA's goals and objectives.

Figue 6. The 5 goals and 26 objectives related to the biophysical indicators.

MPA Goal 1: To conserve and sustain fisheries

- **1a** Objective: Maintain or restore target species populations at/back to population reference points.
- **1b** Objective: Prevent loss of ecosystem functioning and structure and biodiversity.
- **1c** Objective: Protect exploited species at sites and/or life history stages where they become vulnerable.
- **1d** Objective: Prevent overexploitation (if fishing is permitted inside the MPA).
- **1e** Objective: Improve or sustain catch yields in adjacent fishing areas to the MPA.
- **1f** Objective: Improve or sustain replenishment of fishery stocks within the MPA.

MPA Goal 2: To protect biodiversity

- **2a** Objective: Adequate protection and coverage of representative habitats, species, and the community.
- **2b** Objective: Maintain ecosystem function.
- **2c** Objective: Ensure the protection of rare, localized, or endemic species.
- **2d** Objective: Protect areas essential for the completion of life history phases of species.
- **2e** Objective: Minimize threats and damage due to human activities inside and/or outside the MPA.
- **2f** Objective: Design the MPA so that is adequately spreads risk from unmanageable disturbance.
- **2g** Objective: Prevent or remove alien and invasive species and genotypes.

MPA Goal 3: To conserve individual species

- **3a** Objective: Increase or maintenance of focal species.
- **3b** Objective: Restore/maintain habitats and ecosystem functions necessary to focal species survival.
- **3c** Objective: Eliminate/reduce threats to focal species.
- **3d** Objective: Prevent or remove alien and invasive species and genotypes.

MPA Goal 4: To conserve individual habitats

- **4a** Objective: Restore/maintain habitat quality/quatity.
- **4b** Objective: Protect ecological processes essential for habitat existence.
- **4c** Objective: Minimize threats/damage to habitats from activities inside and/or outside the MPA.
- **4d** Objective: Prevent or remove alien and invasive species and genotypes.

MPA Goal 5: To restore degraded areas

- **5a** Objective: Recovery or replenishment of native species/races.
- **5b** Objective: Restoration of ecosystem function(s).
- **5c** Objective: Restoration/rehabilitation of habitat(s).
- **5d** Objective: Eliminate/minimize unnatural threats, damages, and/or pressures to the area.
- **5e** Objective: Prevent or remove alien and invasive species and genotypes.

Figure 7. The 6 goals and 18 objectives related to the socioeconomic indicators.

MPA Goal 1: To maintain and/or enhance food security for local communities

- **1a** Objective: Improve local nutrition.
- **1b** Objective: Improve the availability of locally caught seafood for dietary/food use.

MPA Goal 2: To maintain and/or enhance livelihood opportunities for coastal residents and marine resource users

- **2a** Objective: Improve the economic status and relative wealth of coastal communities.
- **2b** Objective: Stabilize or diversify the community and household occupational/income structure by reducing resource dependency for future generations.
- **2c** Objective: Improve coastal resident access to markets and capital.
- **2d** Objective: Improve or contribute toward the health of local communities.

MPA Goal 3: To enhance the non-monetary benefits of the area to society

- **3a** Objective: Maintain or enhance aesthetic values.
- **3b** Objective: Maintain or enhance existence values.
- **3c** Objective: Maintain or enhance wilderness value.
- **3d** Objective: Maintain or enhance recreation opportunities.

MPA Goal 4: To strive towards the equitable distribution of benefits from coastal and marine resources and the cost of protection

- **4a** Objective: Equitable monetary benefit distribution to and through local communities.
- **4b** Objective: Equitable non-monetary benefit distribution to and through local communities.
- **4c** Objective: Improved equity among social groups (e.g. among minorities, between genders).

MPA Goal 5: To maximize compatibility between the management and local culture

- **5a** Objective: To minimize adverse effects on traditional relationships/systems that support the MPA.
- **5b** Objective: Maintain or enhance ancestral & historical features, sites, or monuments linked to resources.

MPA Goal 6: To enhance environmental awareness and knowledge

- **6a** Objective: Enhance respect and/or understanding of traditional knowledge that supports the MPA.
- **6b** Objective: Increase understanding of "sustainability".
- **6c** Objective: Enhance scientific knowledge.

Figure 8. The 5 goals and 21 objectives related to the governance indicators.

MPA Goal 1: To ensure effectiveness of marine and coastal resource management structures and strategies.

- **1a** Objective: Effective and implemented resource management planning.
- **1b** Objective: Socially acceptable and clearly defined rules for marine/coastal resource access and use.
- **1c** Objective: Presence of effective and accountable decision-making and management bodies.
- **1d** Objective: Sufficient human and financial resources used efficiently and effectively.
- **1e** Objective: Recognize and incorporate traditional/ local/informal governance in management planning.
- **1f** Objective: Ensure periodic effective monitoring, evaluation, and adaptation of the management plan.

MPA Goal 2: To ensure the effectiveness of legal structures and strategies for marine and coastal resource management.

- **2a** Objective: Ensure the existence of adequate legislation supporting the MPA and its management.
- **2b** Objective: Ensure compatibility between formal legal arrangements and traditional local arrangement.
- **2c** Objective: Ensure that national/local legislation incorporates rights and obligations set out in international legal instruments.
- **2d** Objective: Ensure compatibility of international, national, state, and local rights and obligations.
- **2e** Objective: Ensure enforceability of legislation and management rules/regulations.

MPA Goal 3: To ensure that stakeholders representation and participation in coastal and marine resources management is effective and equitable.

- **3a** Objective: Representative and effective systems of co-management exist.
- **3b** Objective: Build the resource users capacity to participate in co-management arrangements.
- **3c** Objective: Strengthen and enhance community organizing.

MPA Goal 4: To enhance compliance by resources users with management plans.

- **4a** Objective: Improve surveillance and monitoring of the MPA and surrounding coastal/offshore areas.
- **4b** Objective: Improve the willingness and acceptance of people to behave in ways that allow for sustainable marine and coastal resources management.
- **4c** Objective: Build the local ability (capacity) to use resources sustainably.
- **4d** Objective: Increase user participation in surveillance, monitoring, and enforcement of the MPA.
- **4e** Objective: Ensure that adequate applications of law and regulations occur/exist.
- **4f** Objective: Ensure the transparency and simplicity of, and the access to, the management plan in order to foster compliance.

MPA Goal 5: To effectively manage marine and coastal resource use conflicts.

- **5a** Objective: To reduce conflicts: (a) within and between user groups, and (b) between user groups and the community or between the community and people outside it.

Figure 9. The 11 biophysical indicators presented in this guidebook, and their relationship to the 5 biophyscial goals and 26 associated objectives.

Biophysical Indicator 1:
Focal Species Abundance

Goal 1	Goal 2	Goal 3	Goal 4	Goal 5
1a, 1e, 1c, 1f, 1d	2c	3a		5a, 5e, 5b, 5d
(objectives)	(objectives)	(objectives)	(objectives)	(objectives)

Biophysical Indicator 2:
Focal Species Population Structure

Goal 1	Goal 2	Goal 3	Goal 4	Goal 5
1a, 1f, 1c, 1d	2d	3a		5b, 5c
(objectives)	(objectives)	(objectives)	(objectives)	(objectives)

Biophysical Indicator 3:
Composition and Structure of the Community

Goal 1	Goal 2	Goal 3	Goal 4	Goal 5
1b, 1c, 1d	2a, 2c, 2g	3b, 3d	4a, 4d, 4b, 4c	5b, 5e, 5c, 5d
(objectives)	(objectives)	(objectives)	(objectives)	(objectives)

Biophysical Indicator 4:
Recruitment Success within the Community

Goal 1	Goal 2	Goal 3	Goal 4	Goal 5
1b, 1e			4a, 4b, 4c	
(objectives)	(objectives)	(objectives)	(objectives)	(objectives)

Biophysical Indicator 5:
Habitat Distribution and Complexity

Goal 1	Goal 2	Goal 3	Goal 4	Goal 5
1b		3b	4a, 4d, 4b, 4c	5c
(objectives)	(objectives)	(objectives)	(objectives)	(objectives)

Biophysical Indicator 6:
Food Web Integrity

Goal 1	Goal 2	Goal 3	Goal 4	Goal 5
1a, 1c	2b	3b		
(objectives)	(objectives)	(objectives)	(objectives)	(objectives)

Biophysical Indicator 7:
Water Quality

Goal 1	Goal 2	Goal 3	Goal 4	Goal 5
	2b, 2d, 2e	3b, 3c	4a, 4d, 4b, 4c	
(objectives)	(objectives)	(objectives)	(objectives)	(objectives)

Biophysical Indicator 8:
Type and Level of Fishing Effort

Goal 1	Goal 2	Goal 3	Goal 4	Goal 5
1a, 1f, 1d, 1e				
(objectives)	(objectives)	(objectives)	(objectives)	(objectives)

Biophysical Indicator 9:
Area Restored

Goal 1	Goal 2	Goal 3	Goal 4	Goal 5
				5b, 5c
(objectives)	(objectives)	(objectives)	(objectives)	(objectives)

Biophysical Indicator 10:
Area Under Reduced Human Use/Impacts

Goal 1	Goal 2	Goal 3	Goal 4	Goal 5
	2d, 2e	3c	4c	5d
(objectives)	(objectives)	(objectives)	(objectives)	(objectives)

Biophysical Indicator 11:
Area Free from Extraction

Goal 1	Goal 2	Goal 3	Goal 4	Goal 5
1e				
(objectives)	(objectives)	(objectives)	(objectives)	(objectives)

Figure 10. The 17 socioeconomic indicators presented in this guidebook, and their relationship to the 6 socioeconomic goals and 18 associated objectives.

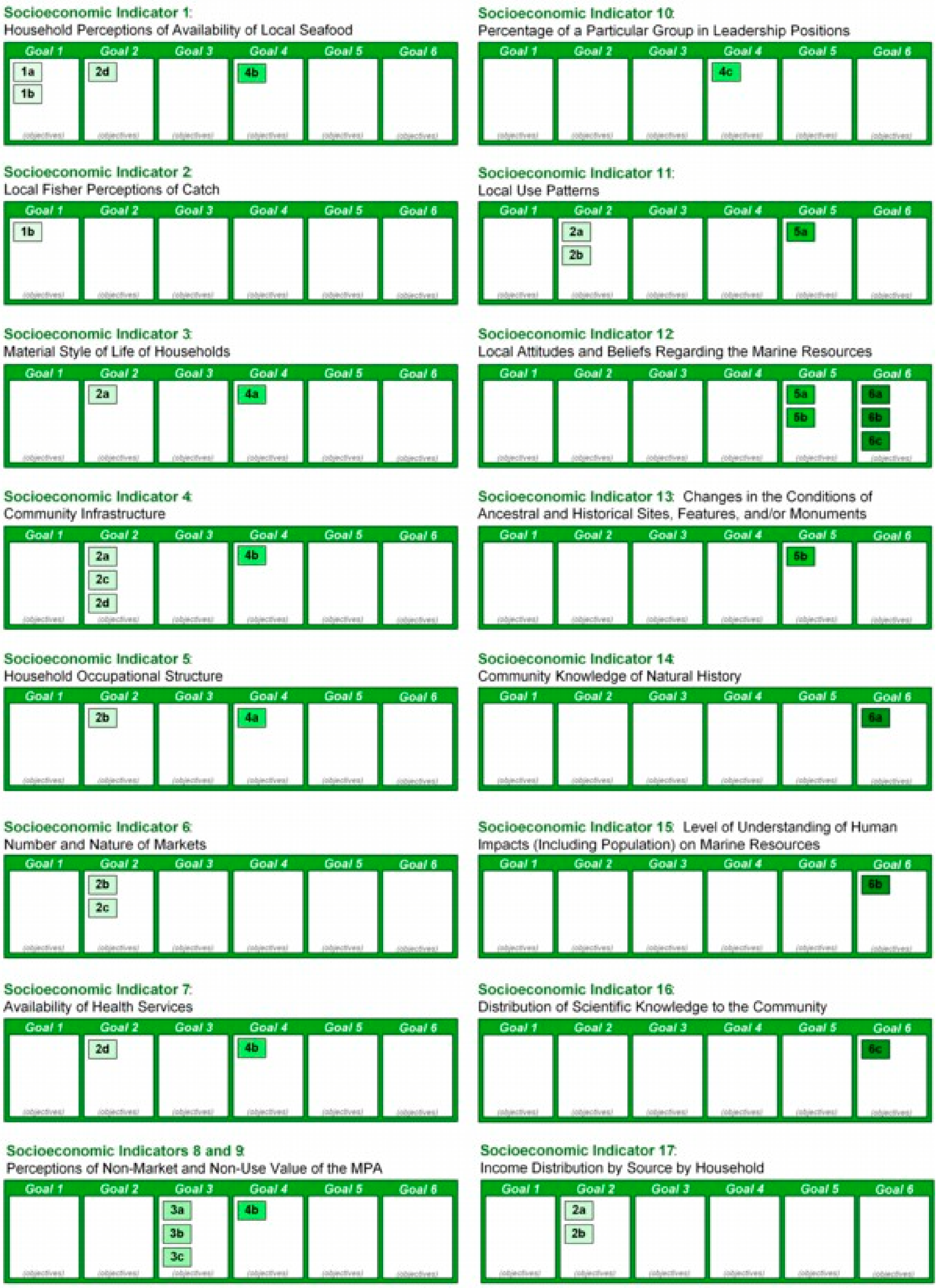


Figure 11. The 16 governance indicators presented in this guidebook, and their relationship to the 5 governance goals and 21 associated objectives.

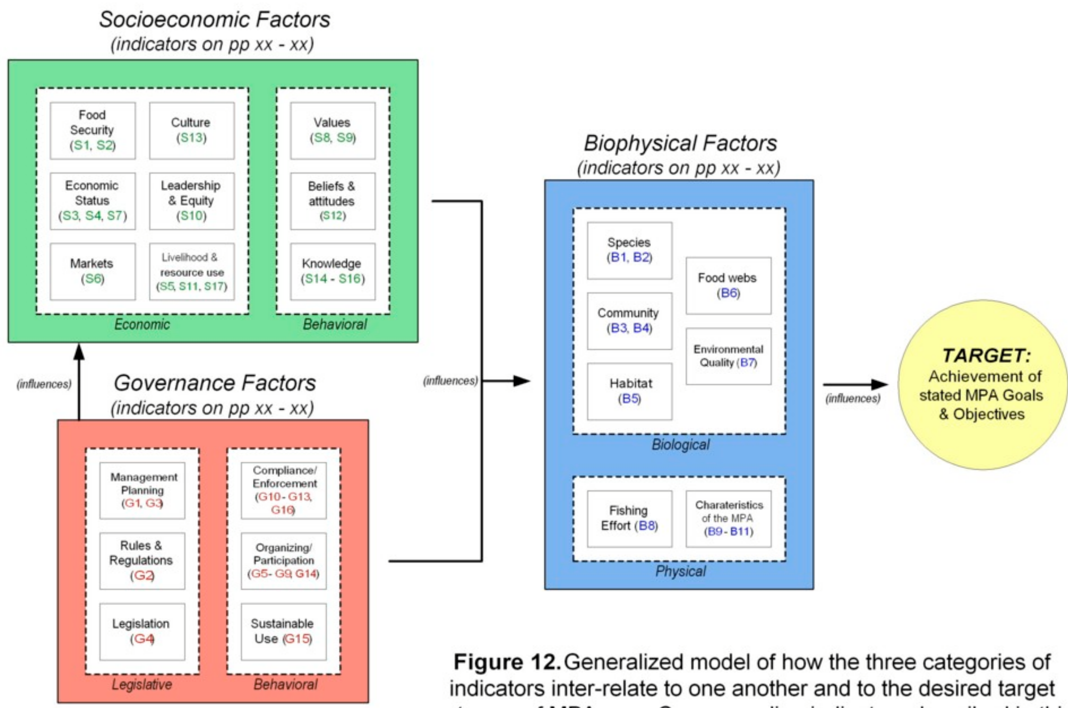


Figure 12. Generalized model of how the three categories of indicators inter-relate to one another and to the desired target outcome of MPA use. Corresponding indicators described in this guidebook are listed in parentheses after each factor.

The Philosophy Behind How the Indicators Are Structured

The indicators were developed to meet several criteria in order to be of the most use to the reader and in being practical. In addition, these criteria should be used to select the most appropriate indicators to measure, especially since a given goal or objective can have one or multiple indicators. Following best practices, a good indicator meets five criteria (Margoluis and Salafsky 1998):

Measurable:	Able to be recorded and analyzed in quantitative or qualitative terms.
Precise:	Defined the same way by all people.
Consistent:	Not changing over time so that it always measures the same thing.
Sensitive:	Changing proportionately in response to actual changes in the attribute or item being measured.
Simple:	Simple indicators are generally preferred to complex ones.

In addition, each indicator has been structured in order to anticipate and meet the needs of the reader. To this end, a common set of questions (see Table 3) are addressed for the reader within each indicator description in Appendix One.

Table 3. The common set of questions addressed under each indicator description.

Question	*Explanation*
▪ Indicator's name?	The number and name of the indicator.
▪ What goals and objectives relate to the indicator?	Which goals/objectives this indicator corresponds with (relating to the generic list of MPA goals/objectives in Figures 6 - 8).
▪ How difficult is measuring this indicator?	A "difficulty rating" (1-5) of how difficult the indicator is to measure (time, skills, logistics).
▪ What is "(indicator name)"?	Brief description of the indicator.
▪ Why should this indicator be measured?	The purpose and rationale of the indicator
▪ What is required to measure the indicator?	Resources (people, equipment) needed to collect and analyze the information.
▪ How are data collected on the indicator?	The method and approach to e used to collect information on the indicator.
▪ How are results interpreted and shared?	The methods and procedures to analyze the data and suggestions on how to present the results.
▪ What are the outputs?	What are the results and how can they be used by the MPA.
▪ What are the strengths & limitations of this indicator?	How useful is the indicator overall and what problems may occur in using the indicator.
▪ Is there an example?	An example of use of the indicator.
▪ Are there other useful sources of Information?	Suggested sources of information on methods and further explanation of the indicator.

Step 3-1 Implement Your Evaluation Workplan

The next step after developing your MPA evaluation workplan is to actually implement it (at the appropriate time). This is not as simple as just beginning data collection. Implementing a detailed workplan requires careful consideration to timing, logistics, and process. Proper implementation of your evaluation plan will require you to:

- Time the commencement of field work and data collection activities appropriately given natural (seasons, tides) and social (holidays, community obligations) conditions.
- Assure that the necessary logistical arrangements for the evaluation team will be overseen when implemented.
- Ensure that all the necessary resources (funds, equipment) are in place according to the plan.
- Ensure that all the necessary approvals and permission required to commence the workplan are in place.
- Ensure that the data collection, management, and analysis systems are in place and have been adequately tested and refined (if necessary).

Also, it is important to remain flexible to changing conditions and needs as you begin to implement the workplan. Expect the unexpected, and know how before hand what is the best way to deal with it.

Step 3-2 Collect, Manage, and Analyze the Data

By this point, the workplan will have been implemented and the process of collecting, managing, and analyzing the data for the selected indicators will begin. Congratulations, your planning and thoughtfulness have paid off!

Analysis is an integral and equal part of data collection – the one should be done independent of the other. The methods of data collection and analysis for each indicator are presented in Appendix One. The needs regarding data management are discussed in Chapter Two and Appendix Three (a methodological primer). Keep in mind that ideally, the indicators you will begin measuring once implementing the workplan should be repeated periodically throughout the lifetime of the MPA.

The open, public participation in and learning through science is a fundamental aim for this guidebook. Regardless of whether or not this is achieved, it is strongly encouraged that practitioners seek out complementary research and academic partnerships in order to attain a thorough and independent validation or rejection of their indicator findings.

CHAPTER FOUR: Sharing and Using Results Adaptively

This Chapter is oriented around guiding the reader through the most important part of the MPA management effectiveness evaluation process:

- Part Four: Sharing and adapting to the results generated.

The steps entailed to complete this parts of the evaluation process is introduced in this Chapter, as illustrated in Figure 13.

Part Four: Sharing and Adapting to Results Generated

If the reader has reached this point in the guidebook, it means that s/he has successfully completed the data collection, management, and analysis activities outlined within her/his evaluation plan (see Chapters Two and Three, Appendix One). As a result, the evaluation team will have generated a set of findings from their work that can now be used to: (a) share results with the identified target audiences, and (b) encourage the adaptation of management practices necessary to improve MPA use. This chapter is designed to provide some initial thinking along the steps necessary for the reader to do these two activities as the final part of the evaluation process.

Step 4-1 Sharing Results with Target Audiences

There are several ways to transmit information to people. These include both one-way and two-way communication mechanisms, as presented in Table 4.

Figure 13. The steps entailed in planning for the MPA evaluation. These steps represent the second step of the overall evaluation process.

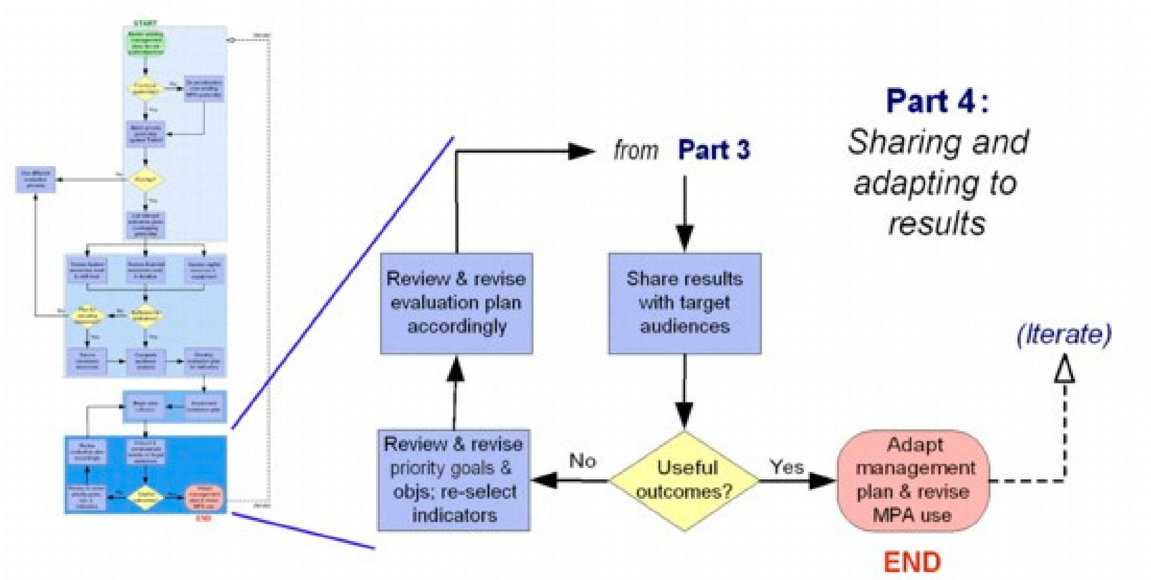


Table 4. Types of one- and two-way communications that MPA practitioners can use to communicate the results of their MPA effectiveness evaluation.

One-way communications	*Two-way communications*
▪ Written materials (reports, papers)	▪ Group discussion (in-person)
▪ Visual materials (posters, pictures)	▪ One-on-one discussion (in-person)
▪ Oral presentations (in-person)	▪ Physical and electronic bulletin boards
▪ Mass media: newspapers, magazines, radio, television, film	▪ Remote communications: telephone, video phone, web camera
▪ Internet: world wide web	▪ Internet: email and internet chat rooms

Once a set of prioritized target audiences and their characteristics have been identified through the audience analysis, the next thing to do is determine using exactly what format these audiences will be most effectively reached with evaluation results. Using matrix results in regard to what is already known about how target audiences prefer to receive information, the practitioner team can develop a logical approach of how to format the relevant one-way and/or two-way communications of results to audiences.

In some cases the ideal format may require the outside assistance of communications specialists such as editors, graphic artists, publication designers, journalists and news agencies, community leaders, professional facilitators, lobbyists, statisticians, and Internet and digital solution technicians.

Once an appropriate format or set of formats identified for transmitting results has been assigned to each target audience, list these formats within the audience analysis matrix.

A useful discussion of results presentation formats commonly used by conservation practitioners can be found in Margoluis and Salafsky (1999).

Next, practitioners should develop an overall <u>results delivery strategy</u> outlining exactly how the relevant presentation formats identified and assigned to target audiences will be undertaken. For example, is there a particular format that can be used to communicate results with multiple target audiences? Which communications formats should come before others in terms of the timing of sharing results with internally and with the outside world? Are there certain communications formats that should be presented simultaneously or within a restricted timeframe?

Practitioners must also approach communicating results and learning in such a way that they will have meaning to the target audience(s) receiving them. Beyond simply the format in which results are given, this requires an understanding of what language, tone, level of prose, and voice (i.e., passive or active) will convey the information to the audience in a meaningful and thought-provoking manner. This approach and style of presentation should be included within the results delivery strategy developed.

When finished, a useful results delivery strategy should outline three important aspects of how results will be presented: (1) which one-way and two-way communication formats to receive information are preferred by the specific target audiences identified, (b) which appropriate format(s) to share results have been selected and assigned to these audiences, and (3) the approach and style that will be used to deliver information through these formats. A sample page from the results strategy of the xxxxxxxx example MPA site can be found in Figure 14.

[@@@ Figure 14 and name of sample site to be inserted.]

What's the Story To Be Shared?

Assuming that an audience analysis matrix (see Chapter Two) and a results delivery strategy have been prepared, practitioners can next focus on which of the key messages they hope to communicate through their results with each target audience. This process is referred to as messaging.

Because the specific content of these messages will not be known until after the evaluation is complete, messaging actually requires two distinct activities and timeframes:

- Identification of the important themes and concepts regarding the marine environment and it's management protection that target audiences are both known to listen to and will want to hear about when results are available. From this can be identified the most important (i.e., top one to three) messages that target audiences will listen to. This part of messaging is done at the outset of the evaluation, before results have been generated; and

- Identification of the specific content relating to the most important messages previously identified, based on the actual results and what they mean or say about the themes and concepts with which target audiences are concerned.

Messaging allows practitioners to keep in mind the critical pieces of information that target audiences will be looking for during the evaluation itself and as results are generated. Part of this is keeping an eye out for interesting or illustrative stories that can be used later after the evaluation is over to support or contradict the results arising out of the indicators. Highlighting and illustrating indicator results with real-world examples, stories, and anecdotes can be powerful tools with certain audiences to build human interest in results and enhancing a practitioner's ability to communicate important messages. For instance, if an important message identified to share with a commercial fishing target audience is that the MPA is replenishing fish stocks, having a story about how one of these fishermen says they are now catching more fish because of the MPA to support the quantitative evidence that there is a three-fold increase in fish populations inside the MPA compared to outside will make for a much stronger message than simply presenting the numbers.

Successful messaging requires that the most important messages be effectively related with the target audiences. To do this, the communicator must consider the format, approach, and style in which key messages should be given. Assuming that a results delivery strategy has already been developed, these considerations will already highlighted so that they can be reviewed and taken into account each time before a communications product is shared with a target audience. Effectively relating messages with target audiences is not always easy, and often requires a mix of practitioner skills, practice, and intuition.

The proof of effectively bridging important messages with identified target audiences is how the target audience subsequently takes action once the message has been delivered. The extent of action to be taken in regard to the MPA and/or desired behavioral changes sought by the practitioner depends on the target audience being communicated with, as identified through the audience analysis. A strategic approach to messaging can be taken by ensuring that key messages are communicated in such a way as to encourage the desired form of action or behavior being sought by the practitioner in presenting results.

When Should Results be Shared?

Once a discrete set of the most important messages are formulated for target audiences based on results generated, a timeline of when to release or deliver these messages using the various presentation formats should be developed. This timeline will likely be largely influenced through the type of formats given and the approach and style in which results are to be delivered. The timeline should logically consider both which messages and what formats will be used to communicate with target audiences. Identification of forthcoming opportunities for outreach can come from reviewing targets in the audience analysis matrix and in logically considering which results and messages should be given.

Tell Your Story!

Put all the pieces together into a communications plan (see Box 7), and put it in motion.

Box 7. Pulling the Pieces Together into a Plan

Assuming that a MPA practitioner has come this far, the outputs of the steps achieved to date related to communicating results can then be folded together to create a *communications plan* through which a clear process of how results will be shared can be logically and strategically organized.

Think of a communications plan as a "cheat-sheet" in how to best share your stories.

A complete communications plan will contain the following elements:

- An ***audience analysis matrix*** (see Chapter Two) identifying who the range of possible internal and external audiences, their characteristics, and a set of ***priority target audiences***;
- A strategy for how and where delivery of results will occur identifying which ***one-way and two-way presentation formats*** will be used with each or groups of target audiences, and the ***approach and style of delivery*** to be taken in this format;
- A set of ***key messages*** with illustrative examples and stories that tells what the results say and that helps to focus the attention of particular target audiences; and
- A ***timeline*** of when messages and presentation formats are to be released and delivered to target audiences.

Once these pieces of the plan are pulled together, an estimate of the necessary time and human and financial resources required to complete the plan can be made. Based on this estimate, the allocation of sufficient time and budgeted resources can be appropriately made. These resources should be available based on the securing of necessary resources at the outset of the evaluation (see Chapter Two).

Step 4-2 Using Results Adaptively and Iteratively to Improve MPA Use

The ultimate purpose of conducting any evaluation is to use the information generated to adapt and improve. In the case of this guidebook, this is to improve MPA use, including its management, planning, impacts, and accountability.

Adaptive management is based on a circular – rather than a linear – management process (see Figure 15). It consists of reviewing the results of actions taken in the past and assessing whether these actions have produced the desired results, and, based on this assessment, making necessary changes in management plans to improve the way that management is done in the future. Evaluation helps management to adapt and improve through a learning process (Hockings et al. 2000). This is a similar process to what all good managers do on a daily basis, linking action and consequences. In using adaptive management there are a few things to keep in mind. Maintain flexibility and be prepared to make changes. If your evaluation reveals that something is not working, change it. Be willing to learn from both success and failure as it will ultimately strengthen your MPA. Learn from the results and act on them, even if you have incomplete information. Use your common sense, your past experience, and use the information that is available to you to make decisions (Margoluis and Salafsky 1998).

[@@@ Insert evaluation cycle diagram (Figure 15).]

Adaptive management is essentially about iteration. That is, repeating the process or steps that bring you successively closer to your desired result. Iteration involves using the results of the evaluation to improve MPA management. It helps management to adapt and improve through a learning process. As you evaluate the MPA you may find that you are successfully achieving your goals and objectives and no changes are needed. Or, you may find that things are not going as well as they could and you will need to make some changes.

The purpose of this guidebook is to get the practitioner to the point where they are adaptively using the evaluation results. There are many good references on adaptive management available (including Walters 1986; Hollings 1978; Hilborn 1992; Gunderson, Hollings and Light 1995; and Salafsky and Margoluis 1999; see Chapter Six). Because of this, the theory behind and development of adaptive management for fisheries and conservation will not be repeated here.

Despite having gone through extensive review and initial field testing, practitioners are encouraged to continue refining the indicators through time and not see them as being “set in stone” or unchangeable. Assuming adaptation of indicators does occur, it is a good idea to keep detailed notes of how this was done and why so that results can be clearly interpreted when shared later. It is for this very reason that the MEI network of MPA practitioners has been established (see Chapter Five).

The indicators presented here will help you to learn more about your MPA and the people and resources which are impacted by it. The indicators are used to promote learning and to improve and share knowledge. The indicators provide information which can be used to learn from both success and failure. The information from the indicators is used to make changes in management plans and practices and to allow people to better understand how and why these changes are being undertaken in this way.

[Example stories (box) on how pilot site used results adaptively]

What If Results Are Not Useful?

There may be cases in which the results that you have obtained from the evaluation are not useful. What can be done? There are several courses of action:

- Check the data collected and the methods used to make sure that they make sense. Were the correct methods used and used in the correct way for each indicator? Was the data inputted correctly? Were the right people interviewed?
- Review the priority goals and objectives to make sure that they were really the ones that are important to your MPA and revise them as needed.
- Review the indicators that were selected to ensure that they match up to the most important goals and objectives and revise them as needed.
- Return to the evaluation plan and revise it according to adjusted and/or new data collection needs. Make sure that the resources are available to collect this data.
- Resume data collection on a revised set of indicators and based on a revised evaluation plan.

Using This Guidebook to Inform New MPAs

The results of the evaluation should be documented so that lessons learned can be shared with other people, with other MPAs, and with the broader conservation and development community. The world is interested in you! New MPAs will be developing and the more that they can learn from your successes and failures, the better they can plan, the less it will cost, and the sooner they can get up and running. It takes years and even decades to demonstrate impacts. However, incremental learning is a part of adaptive management and can be important a new knowledge and experience is quickly transferred to others. In documenting outcomes, a common mistake is to focus only on success and to ignore or hide failures. Everyone can learn from difficulties and others may have faced the same difficulties and through sharing lessons you and others will grow (Margoluis and Salafsky 1998).

Communicating through MPA Networks

At a national level, it is important to ensure that results are deliberately integrated back into the existing (if applicable) MPA framework and/or national marine conservation strategy. Learning should be actively shared within the network of other national MPA sites and MPA practitioners.

[@@@ Discuss the MEI Network (still under development) and online resources. Mention that a discussion of how to get involved in the MEI Network follows in the next chapter.]

[@@@ Discuss international MPA networks.]

[@@@ Insert MEI Internet address and URLs for international MPA networks online.]

CHAPTER FIVE: Networking with Other MPAs

[@@@ Note that the MEI Network and this section are under development.]

The MEI Network

Managers can form national or regional MPA MEI networks or working groups (if none already established)

[@@@ Insert introduction to the IUCN WCPA-Marine/WWF MPA MEI Network (under development) and how to learn more and access resources online.]

[Direct readers to the public website and the 'network' – URL??]

Other MPA Networks

[@@@ Insert list.]

CHAPTER SIX: Useful Materials and Works Cited

Useful Materials

Chapter One

IUCN MPA publications

Hockings, M., with S. Stolton and N. Dudley, 2000. Evaluating Effectiveness: A Framework for Assessing the Management of Protected Areas. IUCN/WCPA.

Margoluis, R. and N. Salafsky. 1998. Measures of Success: Designing, Managing, and Monitoring Conservation and Development Projects. Island Press, Washington, DC.

Greater Than

IUCN MPA publications

CRC,
Salm and Clark,
Agardy's MPA manual

List of refs for MPA-related Design, Context, Planning, and Input indicators (Hockings)

Chapter Two

Chapter Three

Chapter Four

McCann, Thomas and John E. Parks. 2002. "So You Want to Tell Your Conservation Story?" Community Conservation Network, Honolulu, Hawaii. 13 pp.

General Refs:
Basic science introductory text; scientific inquiry
Basic natural/biological science text
Basic social science text
Basic environmental management text

Hockings et al. 2002 (www.enhancingheritage.net)
Courrau 1999
TNC 1999
Cifuentes et al. 2000

Jones 2000
TNC 2000
Ervin 2001

Gunderson, L.; Holling, C.S.; Light, S., ed. 1995. Barriers and bridges to the renewal of ecosystems and institutions. Columbia University Press, New York, NY, USA.

Hilborn, R. 1992. Can fisheries agencies learn from experience? Fisheries, 17(4), 6–14.

Holling, C.S., ed. 1978. Adaptive environmental assessment and management. Wiley, London, UK

Salafsky, N., R. Margoluis and K. Redford. 2001. Adaptive Management: A Tool for Conservation Practioners. Biodiversity Support Program, Washington, DC. www.BSPonline.org

Walters, C.J. 1986. Adaptive management of renewable resources. McGraw-Hill, New York, NY, USA.

Works Cited

[@@@need to collate all citations within this section.]

Bunce, L., P.Townsley, R. Pomeroy and R. Pollnac. 2000. Socioeconomic Manual for Coral Reef management. Australian Institute for Marine Science, Townsville, Queensland, Australia.

Pido, M, R. Pomeroy, M. Carlos and L. Garces. 1996. A Handbook for Rapid Appraisal of Fisheries Management Systems. International Center for Living Aquatic Resources Management-The World Fisheries Center, Penang, Malaysia.

Pollnac, R.B. 1998. Rapid Assessment of Management Parameters for Coral Reefs. Coastal Management report #2205 and ICLARM Contribution #1445. Narragansett, Rhode Island and Manila: Coastal Resources Center, University of Rhode and International Center for Living Aquatic Resources Management-The World Fisheries Center.

Margoluis, R. and N. Salafsky. 1998. Measures of Success: Designing, Managing and Monitoring conservation and Development Projects. The Island Press, Washington, DC.

Pollnac, R., and B. Crawford (2000) "Assessing Behavioral Aspects of Coastal Resource Use." Proyek Pesisir Publications Special Report. Coastal Resources Center Coastal Management Report #2226. Coastal Resources Center, University of Rhode Island, Narragansett, Rhode Island, USA.

The Locally Managed Marine Area Network. 2002. Learning Framework for the Locally Managed Marine Area Network. Foundations of Success, Bethesda, Maryland.

Berkes, F., R. Mahon, P. McConney, R. Pollnac and R. Pomeroy. 2001. Managing Small-Scale Fisheries: Alternative Directions and Methods. International Development Research Centre, Ottawa, Ontario, Canada.

CHAPTER SEVEN: Glossary

- To be added-

APPENDIX ONE: The MPA Management Effectiveness Indicators

A1-1 An Introduction to the Three Categories of Indicators

This appendix outlines a set of 44 indicators, comprising of:

- 11 biophysical indicators
- 17 socioeconomic indicators
- 16 governance indicators

These are individually presented using a standard format (see below).

These 44 indicators are linked to:

- 16 *goals*, comprising of 5 biophysical, 6 socioeconomic, and 5 governance goals; and
- 65 *objectives*, comprising of 26 biophysical, 18 socioeconomic, and 21 governance objectives.

This appendix is organized into three sections, each presenting the three respective categories (biophysical, socioeconomic, and governance) of indicators (Figures 6 - 8), and their related goals and objectives (Figures 9 - 11).

[@@@ Insert Table into Appendix One of indicator overlap with IUCN framework]

As referenced in Chapter Three, the conceptual model illustrates the relationships between the three sets of indicators: socioeconomic, governance, and biophysical. A conceptual model is a diagram of a set of relationships between certain factors (the indicators) that are believed to impact or lead to a target condition (the outcomes which are expected to be achieved by the MPA) (Margoluis and Salafsky 1998). A conceptual model will help you to think about how specific events, situations, attitudes, beliefs, or behaviors affect the status of the MPA.

The conceptual model has three components:

1. The target condition is the situation you intend to influence through the MPA. In the conceptual model presented below, the target condition is represented by the goal and objectives of the MPA.
2. Factors are the specific events, situations, conditions, policies, attitudes, beliefs, or behaviors that you believe affect the target condition. In the conceptual model presented below, the factors are represented by the three sets of indicators – socioeconomic, governance and biophysical.
3. Relationships in the conceptual model are represented by arrows. One factor or set of factors influences another. In the conceptual model presented below, it can be seen that socioeconomic and governance factors influence the biophysical factors. For example, livelihoods influence fishing effort.

The three categories of indicators (biophysical, socioeconomic and governance) are not independent but are related to one another. For example, socioeconomic factors such as the community knowledge of natural history and number and nature of markets are directly related to use of the resource and influence biophysical indicators; changes in biological factors such as community viability influence household occupational structure and enforcement procedures; local attitudes and beliefs regarding the resource influence the degree of stakeholder participation in the management of the MPA. These linkages between indicators are the reason that the three categories of indicators were included. It is also important to think about these linkages when you are doing the analysis and interpretation of each individual indicator, as it will strengthen the uses and application of the output of the indicator.

Navigating Through the Indicators

The indicators represent a large volume of information and technical measures. To make navigating through this information easier, each indicator is presented using a common outline:

Heading	***Meaning***
▪ Name	(number and name of the indicator)
▪ Goal and Objective.	Which goals and objectives this indicator corresponds with (relating to the larger generic list of MPA goals and objectives developed by the project)
▪ Difficulty Rating	A rank of how difficult the indicator is to measure (see below)
▪ What is "(indicator name)"?	brief description of the indicator.
▪ Why should be measured?	The purpose and rationale of the indicator.
▪ What is required to measure the indicator?	Resources (people, equipment) needed to collect and analyze the information.
▪ How are data collected on the indicator?	The method and approach to e used to collect information on the indicator.
▪ How are results interpreted and shared?	The methods and procedures to analyze the data and suggestions on how to present the results.
▪ Outputs	What are the results and how can they be used by the MPA.
▪ Strengths and Limitations of this Indicator	How useful is the indicator overall and what problems may occur in using the indicator.
▪ Example.	An example of use of the indicator.
▪ Useful References and Other Information.	Suggested sources of information on methods and further explanation of the indicator.

Difficulty Rating

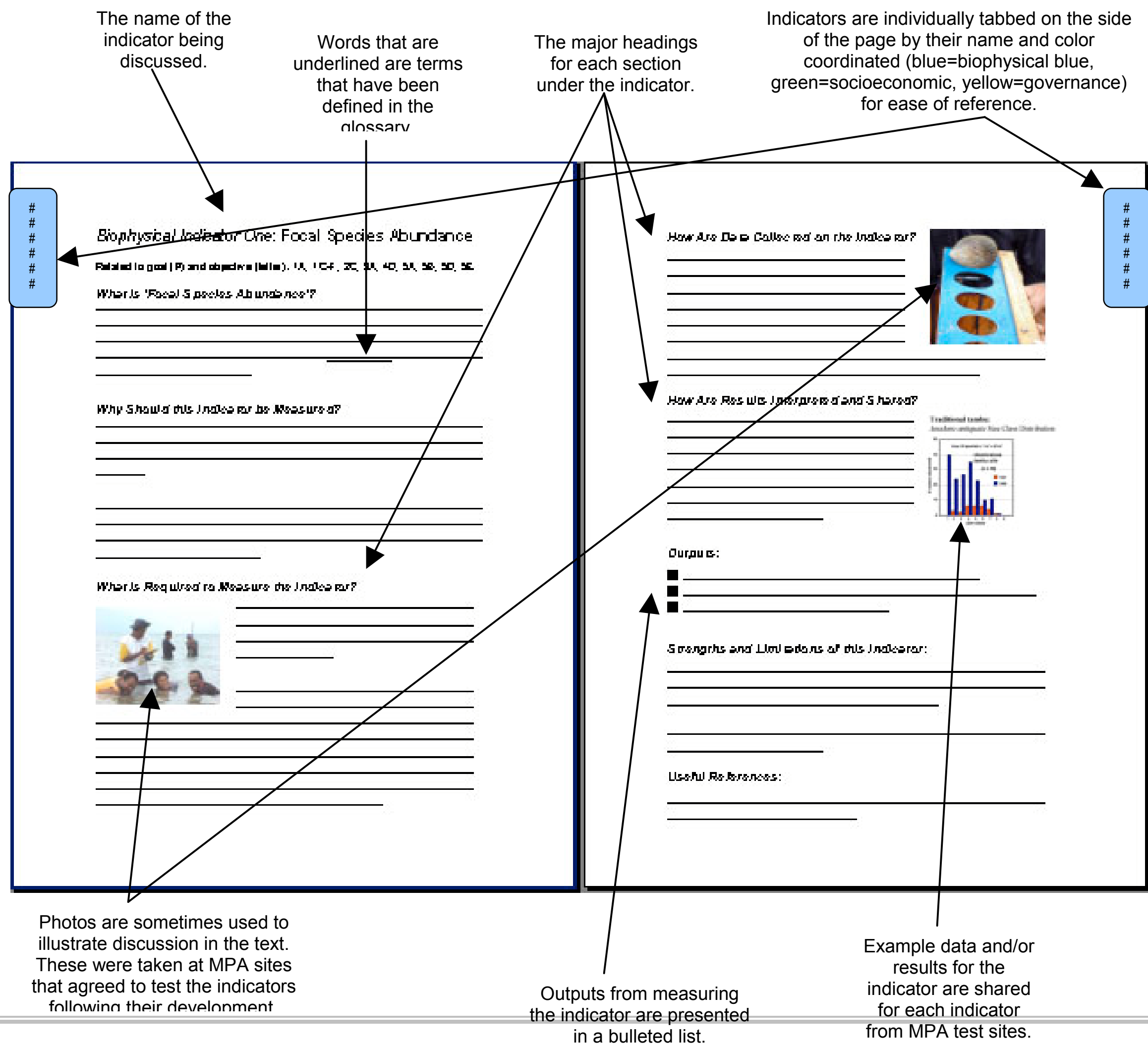
Note that each indicator is provided with a difficulty rating. This is to help the reader understand the relative ease with which the specified indicator can be measured by the evaluator. This ranking takes into account both the time, technical skills, finances, and other resources necessary to undertake measuring the indicator.

1 = the indicator is easy to measure
2 = the indicator is fairly easy to measure
3 = measurement of the indicator requires moderate effort
4 = the indicator is fairly hard to measure
5 = the indicator is hard to measure

Box 8. Tips On Navigating Through the 44 Indicators

Because of the large number of indicators being presented, the layout of each indicator includes a few navigation tools and a standardized format to help the reader identify and sort through the scope of material covered. This standard format and the navigation tools included are highlighted in the following illustration for quick-reference use and navigation ease by the reader.

[@@@ Update figure and add explanations for: goals/objs table, difficulty ratings, and strengths/weaknesses table]



A1-2 The 11 Biophysical Indicators

Figue 6. The 5 goals and 26 objectives related to the biophysical indicators.

MPA Goal 1: To conserve and sustain fisheries

- **1a** Objective: Maintain or restore target species populations at/back to population reference points.
- **1b** Objective: Prevent loss of ecosystem functioning and structure and biodiversity.
- **1c** Objective: Protect exploited species at sites and/or life history stages where they become vulnerable.
- **1d** Objective: Prevent overexploitation (if fishing is permitted inside the MPA).
- **1e** Objective: Improve or sustain catch yields in adjacent fishing areas to the MPA.
- **1f** Objective: Improve or sustain replenishment of fishery stocks within the MPA.

MPA Goal 2: To protect biodiversity

- **2a** Objective: Adequate protection and coverage of representative habitats, species, and the community.
- **2b** Objective: Maintain ecosystem function.
- **2c** Objective: Ensure the protection of rare, localized, or endemic species.
- **2d** Objective: Protect areas essential for the completion of life history phases of species.
- **2e** Objective: Minimize threats and damage due to human activities inside and/or outside the MPA.
- **2f** Objective: Design the MPA so that is adequately spreads risk from unmanageable disturbance.
- **2g** Objective: Prevent or remove alien and invasive species and genotypes.

MPA Goal 3: To conserve individual species

- **3a** Objective: Increase or maintenance of focal species.
- **3b** Objective: Restore/maintain habitats and ecosystem functions necessary to focal species survival.
- **3c** Objective: Eliminate/reduce threats to focal species.
- **3d** Objective: Prevent or remove alien and invasive species and genotypes.

MPA Goal 4: To conserve individual habitats

- **4a** Objective: Restore/maintain habitat quality/quatity.
- **4b** Objective: Protect ecological processes essential for habitat existence.
- **4c** Objective: Minimize threats/damage to habitats from activities inside and/or outside the MPA.
- **4d** Objective: Prevent or remove alien and invasive species and genotypes.

MPA Goal 5: To restore degraded areas

- **5a** Objective: Recovery or replenishment of native species/races.
- **5b** Objective: Restoration of ecosystem function(s).
- **5c** Objective: Restoration/rehabilitation of habitat(s).
- **5d** Objective: Eliminate/minimize unnatural threats, damages, and/or pressures to the area.
- **5e** Objective: Prevent or remove alien and invasive species and genotypes.

Figure 9. The 11 biophysical indicators presented in this guidebook, and their relationship to the 5 biophyscial goals and 26 associated objectives.

Biophysical Indicator 1:
Focal Species Abundance

Goal 1	Goal 2	Goal 3	Goal 4	Goal 5
1a, 1e, 1c, 1f, 1d	2c	3a		5a, 5e, 5b, 5d
(objectives)	(objectives)	(objectives)	(objectives)	(objectives)

Biophysical Indicator 2:
Focal Species Population Structure

Goal 1	Goal 2	Goal 3	Goal 4	Goal 5
1a, 1f, 1c, 1d	2d	3a		5b, 5c
(objectives)	(objectives)	(objectives)	(objectives)	(objectives)

Biophysical Indicator 3:
Composition and Structure of the Community

Goal 1	Goal 2	Goal 3	Goal 4	Goal 5
1b, 1c, 1d	2a, 2c, 2g	3b, 3d	4a, 4d, 4b, 4c	5b, 5e, 5c, 5d
(objectives)	(objectives)	(objectives)	(objectives)	(objectives)

Biophysical Indicator 4:
Recruitment Success within the Community

Goal 1	Goal 2	Goal 3	Goal 4	Goal 5
1b, 1e			4a, 4b, 4c	
(objectives)	(objectives)	(objectives)	(objectives)	(objectives)

Biophysical Indicator 5:
Habitat Distribution and Complexity

Goal 1	Goal 2	Goal 3	Goal 4	Goal 5
1b		3b	4a, 4d, 4b, 4c	5c
(objectives)	(objectives)	(objectives)	(objectives)	(objectives)

Biophysical Indicator 6:
Food Web Integrity

Goal 1	Goal 2	Goal 3	Goal 4	Goal 5
1a, 1c	2b	3b		
(objectives)	(objectives)	(objectives)	(objectives)	(objectives)

Biophysical Indicator 7:
Water Quality

Goal 1	Goal 2	Goal 3	Goal 4	Goal 5
	2b, 2d, 2e	3b, 3c	4a, 4d, 4b, 4c	
(objectives)	(objectives)	(objectives)	(objectives)	(objectives)

Biophysical Indicator 8:
Type and Level of Fishing Effort

Goal 1	Goal 2	Goal 3	Goal 4	Goal 5
1a, 1f, 1d, 1e				
(objectives)	(objectives)	(objectives)	(objectives)	(objectives)

Biophysical Indicator 9:
Area Restored

Goal 1	Goal 2	Goal 3	Goal 4	Goal 5
				5b, 5c
(objectives)	(objectives)	(objectives)	(objectives)	(objectives)

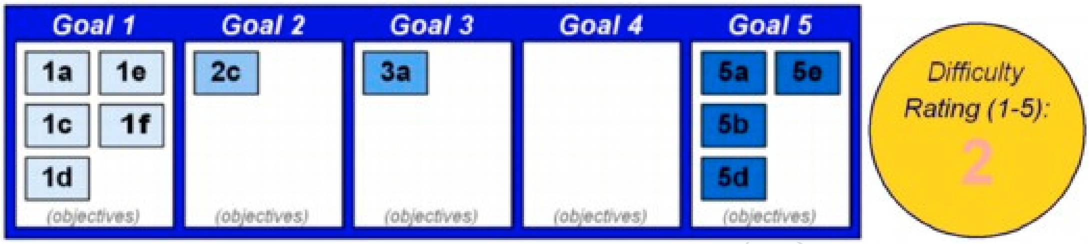
Biophysical Indicator 10:
Area Under Reduced Human Use/Impacts

Goal 1	Goal 2	Goal 3	Goal 4	Goal 5
	2d, 2e	3c	4c	5d
(objectives)	(objectives)	(objectives)	(objectives)	(objectives)

Biophysical Indicator 11:
Area Free from Extraction

Goal 1	Goal 2	Goal 3	Goal 4	Goal 5
1e				
(objectives)	(objectives)	(objectives)	(objectives)	(objectives)

Biophysical Indicator 1: Focal Species Abundance



What is 'Focal Species Abundance'?

Species abundance is both a measure of: (a) how commonly a particular species can be found within a community relative to the other species present ("relative abundance"), and (b) the number of <u>individuals</u> of a <u>population</u> of a particular species encountered within a specified area (in this case, inside and outside the MPA). This indicator is largely oriented toward measurement and understanding under the latter part of this definition (the number of individuals in a species), whereas the former part of the definition (relative abundance) is examined later under the *Structure and Composition of Populations within the Community* (Biophysical Indicator 3). Species abundance is often used as a <u>proxy</u> of population size and status within a specific location. Census of the frequency with which individuals of a population of focal species are encountered inside versus outside the MPA is one of the most commonly used 'success' measures of MPA management effectiveness.

A <u>focal species</u> is one that is considered important and has thus been prioritized within MPA management aims. In other words, focal species are those organisms that are primary protection interest within the MPA. The choice of focal species therefore depends on the aims of the MPA. Examples of how focal species are commonly identified within a MPA include:

(a) Marine resources such as fish, clams, mangroves, and coral reefs that are the most commonly targeted for human use (both extractive and non-extractive) in the area;
(b) Threatened or endangered species;
(c) Rare or endemic species that are important to protect or are of concern;
(d) Invasive/exotic species of concern, such as introduced smothering algae (e.g., *Caulerpa taxifola*) or aggressive and destructive clams and fishes;
(e) Vulnerable species (e.g., slow-growing organisms or those with few offspring) that are less resilient to environmental change than more robust species;
(f) Keystone or indicator species of the area's community ecology, such as butterfly fishes on coral reefs and sea otters on kelp forests;
(g) Species that serve either alone or in conjunction with others as important living space (habitat) for other species within the area, such as coral reef, seagrass, and mangrove species; and
(h) Species of other social or cultural significance to the people managing and/or using the area.

Note that there is a subtle distinction between "focal" and "target" species. "Target" species are organisms of general interest to people, such as fish species that are targeted by local fishers for food, or organisms that are of specific interest in scientific study. Target species may or may not be priorities for management (focal species) within the MPA. In many MPAs, some target species in the area are also of primary management concern and therefore serve as focal species.

Why Should this Indicator be Measured?

This is one of the most commonly identified biophysical indicators of importance to managers. It is also a relatively simple indicator to collect information on. Protection, restoration, and/or management of focal species are often an important objective in using MPAs. A commonly held assumption related to MPA use is that their effective management will lead to improved and/or sustained numbers of focal species within the area under management. To demonstrate whether or not this assumption is holding true under the use of an MPA, the number of individuals within focal species protected under the MPA is often monitored through time and compared to population abundance outside the MPA. Therefore, improved and/or sustained numbers of focal species through time is thought to indicate the effective use of an MPA. Also, illustrating the link between increased numbers of focal species and MPA use is critical to demonstrate for long-term sustainability of management efforts and MPA replication.

In some cases, changes in the abundance of a charismatic focal species (such as marine mammals or large sharks) in the MPA may also be of interest to recreation users, visitors, and the general public. For this reason, a firm understanding of the status and tends in the number of focal species present may be of value to MPA managers for boosting tourism interest and revenues or public support for the MPA's continued existence.

What Is Required to Measure the Indicator?

(1) A list of the focal species needing to be assessed and that can be easily identified underwater (as the case may be). This list should be determined or at least approved by the various stakeholders involved in the designation and management of the MPA.
(2) A representative sample of sites and their locations within the overall area to be surveyed inside and outside the MPA.
(3) An adequate number of staff and/or volunteers (respective to the size of the area needing to be surveyed) that are: (a) trained in biological census (including underwater) and landing survey techniques, (b) can accurately identify the species being surveyed *in situ* and length of individuals encountered, and (c) willing and committed to undertake the necessary survey work.
(4) The necessary survey equipment (e.g., a boat with safety equipment, survey gear including, and SCUBA equipment) needed to sample the abundance of selected focal species populations residing within and outside the MPA.
(5) If applicable, access to aerial photography, satellite imagery, and geographic information systems.
(6) A digital camera (still and/or video) with underwater housing to be used to verify species identities.

It should be noted here that while this indicator is commonly considered one of the most fundamental and important measures to reflect effective MPA use, it will require the adequate budgeting of time and human and financial resources to undertake correctly and adequately. Should the reader be unfamiliar with these requirements and methods outlined below, it is strongly advised that the individual first get in touch with someone who is for their input and guidance.

How Are Data Collected on the Indicator?

The steps to measure the abundance of a selected nearshore marine resource species within a sampled area are thoroughly documented elsewhere in the literature (e.g., Samoilys 1997, English et al 1997) and are not repeated here. The specific technique that should be used to measure abundance largely depends on the behavior and life history of the species needing to be assessed. Generally speaking, three approaches can be used to assess species abundance: (1) through counts of individuals of a species observed during an *in situ* survey, (2) through the assessment of the species extent as either area (e.g., m^2 of coral reef or ha of seagrasses) or biomass (e.g., basal area or leaf litter of littoral forest and mangroves) of habitat cover found present within *in situ* surveys or remotely using aerial photographs or satellite technology, and (3) by recording the landings (fishing catch) of focal species harvested from the area concerned. The methods for undertaking the latter two approaches are discussed under the *Composition and Structure of the Community* (page xx) and *Return on Fishing Effort* (page xx) indicators (Biophysical Indicators 3 and 8).

The following rules-of-thumb can be used in considering how to undertake counts of focal species needing to be surveyed: (1) Sedentary and sessile species can be counted using quadrats/plots randomly assigned within the survey area or systematically and permanently stratified across the area being assessed along transects; (2) Mobile vertebrate (such as reef fishes) and invertebrate (such as crown-of-thorns starfish) species can be sampled through underwater visual census using multiple, GPS-fixed point-counts, belt transects (particularly for sedentary invertebrates), and timed swims (15 minute increments) along fixed depth profiles in relevant habitats. More than one depth profile (i.e., shallower, deeper) should be surveyed respective to the habitat type being surveyed. Cryptic and rare species may need to be surveyed using separate techniques from other focal species of interest. The methodological specifics for these rules-of-thumb are well documented elsewhere and referenced in Chapter Seven.

Whenever possible, it is encouraged that the capture of length/size data along with frequency information occurs under this indicator. This is encouraged in order to provide managers with an understanding of the size-class distribution of the population of focal species being surveyed (see Biophysical Indicator 2, *Focal Species Population Structure*, pg xx) in addition to merely how many individuals are encountered within a given area through time (density). The idea here is to attempt to better understand the population's variation and status related to the number of smaller, juvenile individuals compared to the number of older, presumably reproductive ones. Larger fish and other organisms may indicate that there is spawning stock present. This being said, it is very important to recognize here that for some organisms (e.g., coral reef fishes): (a) growth rates are not always constant throughout an individual's lifetime, and (b) changes between body size and age, while possibly being linearly correlated, may not necessarily be consistent through time. Therefore an understanding of a population's size structure at a specific point in time (or perhaps two points) may not allow the evaluator to accurately understand the growth rates, ages, or reproductive capacity of the population.

In most cases, more advanced research (e.g., biopsy and analysis of fish otoliths, genetic research on individuals in a population) will need to be undertaken in order to more confidently provide an understanding of age structure. Scientific literature may also exist on the size of first reproduction of the focal species of concern. However, the size class data gathered may provide MPA practitioners with a general and perhaps better understanding of whether or not MPA management action is leading a more balanced population structure with both reproductive and immature members.

The collection of abundance data may be more easily achieved with sedentary invertebrates than mobile vertebrates as they may lend themselves to handling and sizing. Fairly accurate length/size estimation can be learned with mobile vertebrates (such as fishes) with some practice (Bell et al 1895; English et al 1997).

Measurement of abundance and length/size data for this indicator should be collected biannually to annually (ideally, quarterly) both within the MPA (treatment area) and outside the MPA (control areas not under management and areas adjacent to the MPA to detect 'spill over' effects and within). The seasonality and life history of the species in question should also be considered as to the timing and periodicy of the survey. Control sites selected must be comparable to the MPA site in terms of their physical (e.g., wave energy, depth, substrate) and biological characteristics, and should be cited within the same general location where the MPA is cited. Repeat surveys should be conducted as close to the same time of month each year as possible.

The indicator can also be useful in regard to the presence/absence of invasive species and the extent (abundance) of their presence. Generally, the methods to assess invasive versus endemic species are the same. However, providing the evaluation team with a separate checklist of known or suspected (which can be sourced through IUCN regional working groups) invasive species can be helpful when undertaking this indicator.

Where applicable, more sophisticated technologies can also allow for monitoring species abundance. For example, the use of underwater video and photography can be used at fixed distances along a transect, and the images later used on land to carefully calculate frequency observations for the focal species. This can be particularly useful in deeper waters when using SCUBA on compressed air for extended periods can be dangerous.

How Are Results Interpreted and Shared?

Collate, enter, and manage data gathered within the MPA effectiveness monitoring database. Calculate a rough estimate of the density of focal species by dividing the number of observations (frequency) within the area sampled (e.g., a 100 x 5 m belt transect). Look for patterns in density: are the individuals uniformly distributed across the areas surveyed or are they clustered in certain areas sampled? Graph the frequency (y-axis) of individuals observed across focal species (x-axis, as histograms) within the community. Compare graphs and monitor changes in abundance of these species through time. Use simple statistical techniques to compare sampled populations with one another and to monitor changes in these populations *[@@@ Cite references here for friendly, beginner statistics and flag in Chapter Seven]*. Write up results for public dissemination. Orally present results visually (graphs and tables) and discuss with selected stakeholder groups, decision makers, and peers. Encourage independent validation of results by outside parties within the sampled area in order to confirm or reject findings and improve the understanding of the effects of management action on the area. Be sure to include any stories or anecdotes that illustrate the results observed from stakeholders.

Based on the abundance data collected within and outside the MPA and the resulting evidence generated, for each focal species population measured choose and record the most appropriate rank from the following list to 'score' the indicator for the time period in question:

1 – Data suggest that the focal population studied within the MPA is **experiencing a notable decline** (greater than or equal to 20% reduction in abundance)
2 – Data suggest that the focal population studied within the MPA is **experiencing a decline** (less than 20% and greater than 5% reduction in abundance)
3 – Data suggest that the focal population studied within the MPA **remains unchanged** (less than or equal to +/-05% change or no change in abundance)
4 – Data suggest that the focal population studied within the MPA is **experiencing growth** (less than 20% and greater than 5% increase in abundance)
5 – Data suggest that the focal population studied within the MPA is **experiencing notable growth** (greater than or equal to 20% increase in abundance)

Therefore, if the abundances of three focal species are being studied by a MPA team, three separate indicator scores should be awarded at the end of the evaluation period.

Also, based on completed surveys within and outside the MPA, chose and record the most appropriate rank from the following list for the time period in question:

1 – Known invasive species **were observed** within the MPA
2 – Known invasive species **were not observed** within the MPA

For those known invasive species observed and sampled in terms of abundance, repeat the above 5-point abundance scale for each (or for the most threatening species).

Outputs

- An indicator score (1-5) for each focal species evaluated;
- Known presence/absence of invasive species within the area;
- An estimate of density per unit area within the area surveyed at a point in time;
- Abundance profiles (frequency) for focal species observed across a community surveyed at a point in time;
- A profile of invasive/exotic species present in the community (if applicable);
- The relative abundance of the focal species in comparison to the other species observed within the community (see *Composition and Structure of the Community*, Biophysical Indicator 3).

Strengths and Limitations of this Indicator

Collecting abundance data can be done rapidly, inexpensively, and with a minimum of specialists. Also, the survey techniques used is non-destructive to the species or community being sampled. Species abundance is one of the most commonly used indicators to gauge MPA effectiveness, and is often closely related to why MPAs are undertaken (the goals and objectives). In this regard, abundance is an important but easy measure to be undertaken.

However, the abundance observed for a focal species may be difficult to infer beyond the sampled area, and thus large areas must be surveyed for larger sized MPAs.

These techniques may at first appear intimidating to managers that do not have this training or experience. Also, surveyors must be trained and experienced. Expertise in undertaking the standardized methods involved will increase the likelihood that they are executed exactly as previously done when performing repeat measurements. This is very important because precision will allow for comparability of results through time and space and useable for statistical analysis.

This indicator is geographic-specific and therefore often limited in its spatial relevance in large MPAs and surrounding areas.

Finally, counts are limited to depths at which diving can be safely undertaken. To determine the focal species abundance from populations in deeper waters, catch-landing surveys (see Biophysical Indicator Nine) of deep-water species caught should be undertaken.

Measurable?	+	
Consistent?	+	
Precise?		-
Sensitive?	+	
Simple?	+	

Example

[@@@ Example data to be inserted later from pilot site collection.]

Useful References

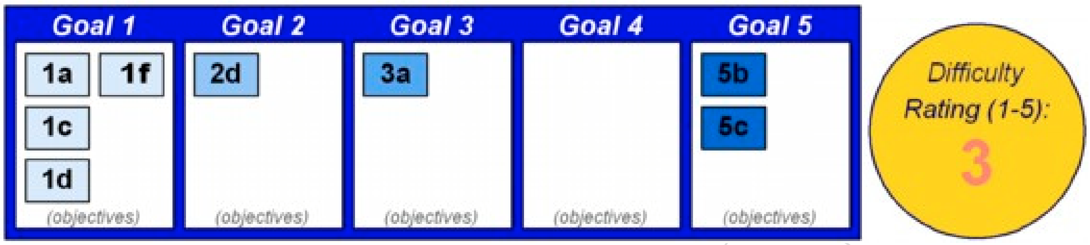
Bell, J. D., G. J. S. Craik, D. A. Pollard, and B. C. Russell (1985). Estimating length frequency distributions of large reef fish underwater. Coral Reefs, 4: 41-44.
English, S., C. Wilkinson, and V. Baker, editors (1997). Survey Manual for Tropical Marine Resources. 2nd Edition. Australian Institute for Marine Science, Townsville, Queensland.
Rogers, Caroline. 2001 Coral Reef Monitoring Manual for the Caribbean and Western Atlantic, NPS, Virgin Islands National Park.
Samoilys 1997 Manual for Assessing Fish Stocks on Pacific Coral Reefs. DPI, Qld.

[@@@ Citation being sourced at time of drafting: Choat, Howard J. – James Cook University – references and review of indicator; Donaldson, T. – University of Guam – references on timed swim and size/age structure for fishes.]

[@@@ Cite references here for friendly, beginner statistics and flag in Chapter Seven.]

[@@@ Insert URLs for these resources]

Biophysical Indicator 2: Focal Species Population Structure



What is 'Population Structure'?

One of the most important determinants to a population of a species being <u>viable</u> (the probability of continued persistence) is an adequate number of reproductive adults (spawning stock) present within the population. The population structure of a focal species is a representation of the frequency with which specific sizes of individuals are likely to be encountered within the population. The assumption is that a population structure under natural conditions and experiencing no human influence or natural disasters has a higher degree of probability that it will be able to replenish (maintain) itself through time and persist than that of one which is under human pressures. In this sense, this indicator is intended to be dynamic rather than static, serving as a forecast/predictor of trends occurring within the focal species population rather than simply providing a one-off 'snapshot' of how frequently the species occurs (Biophysical Indicator 1).

Important factors influencing size class distribution within the population include the regularity of spawning and timing of larval settlement and recruitment events, as well as the level of juvenile recruitment and survivorship to the population. As the number of individuals found in a population is in part a function of its structure, this indicator is again closely related to and associated with *Focal Species Abundance* (Biophysical Indicator 1).

Why Should this Indicator be Measured?

A commonly held assumption related to MPA use is that their effective management will lead to the ability of *in situ* populations of focal species to persist within the area. An effectively managed MPA is one that is thought to host populations of focal species that are comprised of an adequate number of individuals distributed across size classes (juveniles through assumed adults). In many cases, the structure and potential of focal species populations to persist through time – not just merely their abundance at any point in time – is very important in terms of the underlying management rationale in using MPAs. Moreover, demonstration of a stabilized size class structure and improved focal species viability through the use of MPAs is an important benefit needing to be clearly demonstrated in order to support long-term sustainability of management efforts.

In some cases there will be sufficient scientific understanding regarding the life history and reproductive biology of the focal species to roughly estimate the target minimum number of reproductive adults needed to be present to ensure a viable population within a specified area. However, sometimes this information may not be known of fully understood. In such cases, by building the knowledge base regarding the size class structure and growth rates of a population of marine resources, this will in turn improve people's understanding of the species and have important management consequences both within the MPA and beyond.

Another assumption is that networks of MPAs are required to sustain certain focal species populations through time due to their wide-ranging (geographic distance) life history characteristics such as lengthy larval stages, large home ranges, distance migration to spawning aggregations, etc.

As with *Focal Species Abundance* (Biophysical Indicator 1), knowing whether or not populations a charismatic focal species in the MPA are growing or dwindling may be of interest to visitors or the public and used to generate additional revenues and/or management support.

What Is Required to Measure the Indicator?

This indicator can be collected concurrently with Biophysical Indicator 1 (*Focal Species Abundance*), but may in some cases require distinct methods. For the most part this indicator shares the same five requirements for measurement. In addition, the following are required for assessing size classes of individuals: (1) staff that have experience and are trained in sensitively and non-destructively capturing, handling, sizing, and returning the focal species being studied; and (2) the necessary equipment (e.g., fish measuring board, soft tape measure, sizing sticks, calipers, balance) to size individuals captured.

Tagging equipment can also be used with focal species that lend themselves to capture-mark-recapture (CMR) study, ranging from a simple plastic tag kit to a package that includes a high-tech and expensive radio telemetry tracking system. Collection plates, nets, and other tools for coral recruits and juveniles and traps for settling lobster, conch, beche-de-mer, or other invertebrate larvae may also be necessary for sampling smaller individuals of focal species populations. This will require a comparatively larger set of skills, time, and finances than the lower cost methods outlined under focal species abundance.

Data collection for populations of species that have large geographic ranges may require multiple sampling locations within the area concerned or (ideally) within the network of MPAs that have been set up to provide representation throughout this range.

Age assessment is not mandatory under this indicator although may be desirable depending on the management objectives and focal species of interest. Age assessment also requires staff with the technical skills necessary to determine the ages of individuals collected from site, the collection and holding equipment necessary, and access to the laboratory facilities needed to complete the age analysis of specimens collected. Scientific age assessment also often requires additional time and finances to complete than simply sizing of individuals.

Measurement of a population's viability can be more directly undertaken through the use of other documented methods such as biological and genetic analysis of spawning and reproductive potential or in-depth population recruitment surveys. Such studies will require the sampling, and thus landing and mortality, of specimens that may or may not be compatible with MPA goals (e.g., no-take). An additional approach is through the development of an index of biotic integrity (IBI), the details and methods of which are documented elsewhere in the literature (*insert WHOI citation*) and not repeated here. However, such research will require significantly more labor, finances, and time to more accurately gauge this indicator then the comparatively simple size class structure data collection and analysis methods suggested below.

How Are Data Collected on the Indicator?

Population viability can be determined from the following parameters: (a) the size (juvenile versus adult stages) and age structure of the surviving population, (b) the breeding or spawning potential and event regularity, and (c) the recruitment potential and event regularity. It is very important to recognize that juveniles of many coastal species occur in habitats that are quite different than where they do as adults, so multiple habitats would need to be surveyed.

The recommended minimum data to be collected for this indicator is the capture of size class information of focal species surveyed within and outside the MPA. The survey methods used to sample individuals are the same as those described for *in situ* survey under *Focal Species Abundance*. In most cases, size information can be easily collected during *in situ* surveys by: (a) estimating the length of mobile individuals (such as reef fishes) observed at distance from within the census area (see Bell et al 1995; English et al 1997), (b) measuring the actual length (in cm; e.g., the estimated caudal or total length of fishes observed underwater or captured for release, the dorsoventral length of bivalves, the carapace length of crustaceans) or size (in diameter) of live individuals (not taken), or (c) measuring the actual length of individuals landed (catch survey). Size data captured can also be parsed within cohorts, or size classes, within evenly spaced (e.g., 1 or 10 cm) intervals. The frequency with which individual size classes are observed can then be scored and a profile of the size class distribution of the population surveyed created. Size structure may also serve as a simple proxy for age structure with some focal species. Generally speaking and holding all things equal, an adequate and stable number (allowing for natural fluctuations) of surviving juveniles and reproductive adults within the population structure will increase the population's ability to be viable through time.

The collection of age structure data is not mandatory under this indicator, although may be desirable. Timed growth studies are often conducted through CMR study of mobile individuals that have been tagged, released, and then later recaptured or monitored using telemetry. Even simplistic CMR monitoring approaches used inside MPAs and control sites can provide important information on the rate at which individuals grow over time (i.e., the size-age relationship). The age of first reproduction can also be studied through genetic analysis and from the examination/dissection and analysis of reproductive organs, otoliths, and other morphological characteristics of specimens of both genders.

Fecundity (as an estimated number of eggs produced by the population per unit time) and recruitment studies likewise could be conducted on the focal species in question that will assist in determining the viability of the population through time. By understanding the reproductive capacity of a focal species population and spawning potential, a more accurate understanding of the size/age requirements for a viable population can be developed for management purposes. This information will help inform managers of the 'threshold' for population sustainability in regard to the size and age structure of a resident species.

Recruitment studies of the focal species to the MPA can be undertaken using visual census of small size class individuals and juvenile stages or through capture and sizing of juveniles using nets (note that this will likely lead to mortality) and measurement of body sizes. Recruitment and larval settlement are discussed more under Biophysical Indicator 4 (*Recruitment Success within the Community*).

Once size/age information have been collected and a profile of the frequency of individuals found within each class of the population has been created, a qualitative (low, unpredicted, or high) or quantitative (probability based on reproductive capacity) measure of overall population viability can be determined.

Viability data (at a minimum, size class information) should be captured at least annually and as part of the *Focal Species Abundance* (Biophysical Indicator 1) survey. Ideal timing of measurement will depend on the life history of the focal species being studied.

How Are Results Interpreted and Shared?

Collate, enter, and manage data gathered within the MPA effectiveness monitoring database. For size data, graph the frequency (abundance; y-axis) against size classes (x-axis) of individuals observed. Is the resulting population structure one that would be considered normal or naturally occurring? Are there a sufficient number of juveniles and reproductive adults present in the population? Monitor the population structure and abundance of size classes through time. Use simple statistical techniques (cite) to compare sampled populations with one another and to monitor changes in these populations. Write up results for public dissemination. Orally present results visually (graphs and tables) and discuss with selected stakeholder groups, decision makers, and peers. Encourage independent validation of results by outside parties within the sampled area in order to confirm or reject findings and improve the understanding of the effects of management action on the area. Be sure to include any stories or anecdotes that illustrate the results observed from stakeholders. See Tawake et al (2001) for a simple case example of how abundance and size classes are being easily monitored through time within a small MPA by local Fijian residents.

If it has been collected, age data can be plotted against frequency on a similar graph for analysis and discussion purposes. How does the structure of age data (cohorts) compare against size class distribution results? Are they intuitive of one another? Develop a profile of the reproductive potential (if applicable) of the focal species population and how this profile compares against what is known about the life history of the species. How does this profile predict the ability of the population to maintain itself through time? Finally, if applicable present the number/density of recruits and juvenile sizes resulting from the recruitment survey and discuss how they relate to the observed size class distribution.

Annual average length-frequency distributions can also be used to generate simple and robust length-converted catch curves (insert citation), which provide estimates of the total mortality rate prevailing in successive cohorts and an objective measure of the population, particularly in comparison to other populations of the same species.

Based on the size class structure data collected within and outside the MPA and the resulting evidence generated, for each focal species population measured choose and record the most appropriate rank from the following list to 'score' the indicator for the time period in question.

1 – Data suggest that the focal population structure studied within the MPA is **experiencing a notable decline** (greater than or equal to 20% reduction in size classes) in terms of the number of juveniles and/or adults present
2 – Data suggest that the focal population structure studied within the MPA is **experiencing a decline** (less than 20% and greater than 5% reduction in size classes) in terms of the number of juveniles and/or adults present
3 – Data suggest that the focal population structure studied within the MPA is **remains unchanged** (less than or equal to +/-05% change or no change in size classes) in terms of the number of juveniles and/or adults present
4 – Data suggest that the focal population structure studied within the MPA is **experiencing growth** (less than 20% and greater than 5% increase in size classes) in terms of the number of juveniles and/or adults present
5 – Data suggest that the focal population structure studied within the MPA is **experiencing notable growth** (greater than or equal to 20% increase in size classes) in terms of the number of juveniles and/or adults present

Therefore, if the size class distributions of three focal species are being studied by a MPA team, three separate indicator scores should be awarded at the end of the evaluation period.

Outputs:

- An indicator score (1-5) for each focal species evaluated;
- The size class distribution (graph) of each focal species studied at a point in time.

Optional outputs include:

- The age structure of the focal species being surveyed at a point in time;
- A length-converted catch curve and estimated mortality rate;
- A profile of the reproductive potential (including spawning and breeding ability) of the focal species compared to known life history;
- A profile of the number and size of recruits/juveniles within the sample area;
- A proxy of how 'viable', or the likelihood of persistence, the population is.

Strengths and Limitations of this Indicator:

The strengths and limitations of this indicator are similar to those described under *Focal Species Abundance* (Biophysical Indicator 1). Size class information is generally rapidly, easily, and inexpensively collected within the *in situ* survey methods suggested under *Focal Species Abundance*. Therefore, this indicator can be captured with little additional investment to Biophysical Indicator 1. Size class information is an accepted standard in understanding the viability of a population and widely understood. Also, regular collection of size class information can be useful in understanding and predicting the sustainability threshold of focal species that are targeted for fisheries harvest within or outside the MPA. In this sense, the indicator can both serve to measure MPA effectiveness as well as improve *in situ* fisheries management understanding and help to set harvest limits.

However, to confidently build an understanding of a population's structure using this indicator requires time. It is dangerous to attempt to accurately characterize a resident population and/or confidently make management decisions based on a single instance ('snapshot') of collected data in the absence of several years of prior data. Therefore, this indicator is inherently 'weak' without subsequent years of comparable information. With time, the validity of the indicator (and the ranking chosen) will improve and become a valuable tool to managers and decision-makers. For this reason, this guidebook recommends caution in interpreting and using results generated from collection this indicator when done during the first few years/cycles of evaluative efforts in the MPA.

While useful, the capture of age, reproductive potential, and recruitment information will add to the complexity, labor, time, and cost requirements of data collection under this indicator. Accurate estimates of individuals' sizes through remote estimation requires skill and experience and is not easily undertaken by novices or managers without existing training.

[@@@ Insert a strength/weaknesses table with support from pilot site test results/feedback]

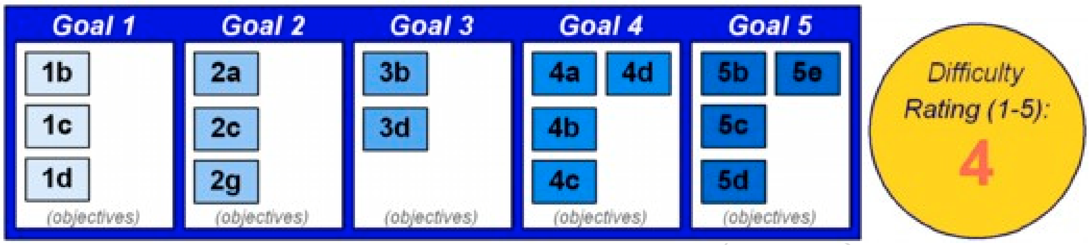
Example

[@@@ Example data to be inserted later from pilot site collection.]

Useful References

Bell, J. D., G. J. S. Craik, D. A. Pollard, and B. C. Russell (1985). Estimating length frequency distributions of large reef fish underwater. Coral Reefs, 4: 41-44.
English, S., C. Wilkinson, and V. Baker, editors (1997). Survey Manual for Tropical Marine Resources. 2nd Edition. Australian Institute for Marine Science, Townsville, Queensland.
Tawake et al (2001) Conservation Biology in Practice *[@@@ Finish citation]*
Woods Hole IBI references*[@@@ Finish citation]*
[@@@ Insert citation that emphasizes low-cost, low-tech size class data collection methods]
[@@@ Cite references here for friendly, beginner statistics and flag in Chapter Seven.]
[@@@ Insert references and online addresses for ecological statistics software]
[Insert URLs for these resources]

Biophysical Indicator 3: Composition and Structure of the Community



What is 'Composition and Structure of the Community'?

A community is a collection of different and interacting populations of organisms (biota) found living together in a defined geographic area, including indigenous and exotic organisms. This indicator is concerned with the species that both comprise habitat types and the organisms residing on them in forming the community – i.e., what is in the community. This indicator aims to collect information on multiple populations of species within the community, and is not expected that measurement of every population occurring within the community will realistically occur.

The *composition* of a community of species is an inventory of all of the species present in a community and their relative abundance (respective to one another). Species richness, dominance, diversity, and relative abundance all are characteristics of community composition.

The *structure* of a community of species is a summary description of how the numbers and relative abundance of species occur within a community and are found spatially across the physical environment (form) and habitats in or upon which the members (composition) of the community live. Community structure can therefore be described as the numbers and relative abundances of all species within the community and how they are organized into zones, or strata, of living space. For example, at a basic level the community structure of a coastal ecosystem could be considered within intertidal, neritic, and benthic zones. Habitat diversity and relative habitat abundance are both important determinants of community structure. Abiotic characteristics (e.g., geology and light) also largely influence community structure.

Why Should this Indicator be Measured?

This is one of the most commonly identified biophysical indicators of high importance. The maintenance or restoration of the naturally occurring composition and structure of a resident community is often desired so as to encourage the "integrity" of an ecosystem, including it's health, functioning, and resistance to disturbance. Understanding changes – and the extent and sources (both natural and anthropogenic perturbations) of such changes – occurring within the community composition and structure are therefore prerequisites to diagnosing and treating ailing ecosystems. Measurement of community composition and structure through time allows managers to evaluate whether or not their management efforts (in this case, the use of an MPA) are having the desired effects on the target ecosystems.

Additionally, understanding what species comprise a community or organisms and how these organisms are structured within the natural setting allows managers to prioritize and monitor coastal areas requiring management action. For example, in improving the understanding of which nearshore areas host the highest levels of species richness and diversity managers can begin to adaptively prioritize their management efforts and allocate resources accordingly as conditions change. This increases the investment value of management efforts through time and reduces risk.

What Is Required to Measure the Indicator?

(1) A representative sample of sites and their locations to be surveyed throughout the managed area (both inside and outside the MPA). These sites must be stratified across known zones/habitat types in order to ensure that adequate observation occurs across the existing community structure.
(2) An adequate amount of time and resources to survey and record the various species and habitats present within the sampled area and across zones/habitats. This may become increasingly time intensive and cost prohibitive with larger scale MPAs.
(3) An adequate number of staff and/or volunteers (respective to the size of the area needing to be surveyed) are needed who are: (a) trained in underwater census, (b) can accurately identify the species being surveyed *in situ*, and (c) willing and committed to undertake the necessary survey work. A minimum tam of four people is recommended.
(4) The necessary survey equipment (e.g., a boat with safety equipment, survey gear, and snorkel, hookah, or SCUBA equipment) needed to observe the various species and habitats observed within the sampled area (both inside and outside the MPA).
(5) The ecological knowledge and experience necessary to interpret changes in community composition and structure. This may require consulting the services and/or advice of a professional ecologist familiar with the study area. This caveat comes from recognition that there are rarely simple, universal benchmarks that will describe such changes everywhere they are encountered.

How Are Data Collected on the Indicator?

This indicator is closely related to Biophysical Indicators 1 and 2. Similar to *Focal Species Abundance* (Biophysical Indicator 1), this indicator is largely collected through *in situ* survey within the marine setting being managed. The methods for undertaking these surveys are relatively straight-forward. However, unlike the first two biophysical indicators, the survey used for this indicator is designed to observe *all*, or a majority of, living organisms found in a particular location, as opposed to selected focal species. Therefore the survey is likely to require significantly more energy, time, and capital resources. As a consequence data collection for this indicator should be executed simultaneously with data collection for Biophysical Indicators 1 and/or 2 in order to maximize the return on the team's investment of monitoring resources (time, energy, finances, etc.).

First, identify the various habitat types and/or zones contained within the area being managed and contained within the MPA. Next, within each zone/habitat type complete an inventory of all of the types (species) and abundances (frequency) of organisms observed within each community. The survey technique used for inventorying will depend on the zone/habitat in which the survey is undertaken (see Biophysical Indicators 1 and 2 for specific methods). Ideally, the evaluation team would have a measure of the area surveyed. Generally speaking, however, randomized timed swims and stationary point counts across the zones/habitat types surveyed will suffice in lieu of visual censuses along transects or within quadrats. These methods are feasible and well documented in detail elsewhere in the literature (*insert complete citations: Samoilys for stationary point counts; CI Rapid Assessment Program methods for randomized timed swims*).

Species inventory is often achieved in deep-water habitats through examination of trawl or seine net catches. As such techniques are destructive and likely not suitable for regular use under a sustainable monitoring protocol, this method is not recommended.

Data collected should include the species (including habitat species) observed, the number observed within the sampled area, and the zone/habitat type(s) where the sampling occurs. Exotic and rare organisms to the community should also be noted and their frequency observed recorded. Endangered and endemic organisms should be given thorough attention.

The composition and structure of habitats (see Biophysical Indicator 5) can also be documented through estimation of the percent cover and other appropriate measures of abundance. In particular, biotic structural components of habitats (e.g., corals, seagrasses, mangroves, kelps, soft-bottom communities) should be adequately sampled to estimate coverage. Techniques to do this include *in situ* snorkel and SCUBA survey approaches (e.g., manta tow, line intercept transect, quadrats) as well as remote sensing (e.g., aerial photography, satellite imagery, videoed transects) technologies. The selection of a technique depends largely upon the abilities and resources of the team undertaking the habitat composition study and the type of habitat being inventoried. This may require separate surveys to be conducted from the species inventory described above. Where possible, it is encouraged that the habitat composition surveys be conducted concurrently with other surveys designed to collect other indicator information. For example, during a transect survey across an area of coral reefs sampled one group of divers may collect species abundance and size data (Biophysical Indicators 1 and 2) concurrently while a second group is conducting a line intercept along the transect to provide a profile of the community composition of the coral reef habitat.

Species inventories and habitat cover surveys should be conducted at least every two or three years, ideally annually – particularly if impacts are evident. A sufficient number of replicate surveys must be sampled across study sites in order to have confidence in results generated in terms what is and is not there and in what relative quantities. If changes are observed in the composition and diversity of species, dominance of certain species, and presence of new or exotic species, these changes may necessitate increased effort to monitor these specific observations more regularly (annually or twice a year). The timing of inventories undertaken during the year should be repeated consistently and take into account known life history events such as spawning, recruitment, seasonal migration, etc.

Data collection for this indicator can be liked to data collection under *Food Web Integrity*, Biophysical Indicator 6. Additionally, as this indicator is tied to better understanding the effects of human extraction and other activities on the marine environment, it has informational links to several other indicators, most notably Biophysical Indicator 10 and Socioeconomic Indicators 5, 6, and 11.

How Are Results Interpreted and Shared?

Collate, enter, and manage data gathered within the MPA effectiveness monitoring database. There are several simple analyses that can be undertaken by calculating species composition (i.e., diversity in terms of richness, evenness) and structure (relative abundance and physical distribution) using the data that have been collected. In particular, a minimum of two attributes must be calculated in order to measure this indicator: (1) species richness, and (2) relative species abundance. From here, two additional attributes can optionally be calculated by the evaluation team: (1) species evenness (using the Shannon and Simpson's Indices) and (2) habitat diversity. The methods for calculating all of these attributes are discussed below.

First, species richness is measured as the total number of species present within the community. To do this, generate a list of all species observed within the managed area and categorize each by habitat type/zone surveyed. Generating a profile (matrix/diagram and describe) of the habitat composition and structure of species found within and outside the MPA will also be useful. The total number of species present from this list can be monitored through time to keep track of changes/trends. Note that the evaluation team will need to keep abreast of any relevant taxonomic changes or new understandings related to speciation, particularly with marine organisms where new information is continually updating taxonomic relationships such as with coral reef fishes.

Next, graph the relative species abundance (or create a relative abundance index) by plotting the commonness (grouped from most to least on the x-axis, and listed by name) of species present in the community against the frequency with which they were observed (y-axis) relative to one another. This can further be analyzed at a habitat-specific level. Highlight/identify exotic, rare, endangered, and commonly found organisms within this description. Characterize the community structure by determining and describing the relative abundance of various species present within the community.

Also, from this point species evenness can be measured as the proportion of individuals among species based on relative abundance respective to the degree that a species dominates a community (dominance ranking). Calculate a measure of dominance (that is those that biologically control a community by most influencing the surrounding environment) using the Simpson's Index of concentration *(insert citation for methods of index)*. Using this index, determine which species are considered to most dominate the community. Species evenness can be calculated using a Shannon Diversity Index, a relatively simple calculation well documented in the literature *(insert citation for methods of index)*. Comparison between indices can be analyzed using a modified T-Test method to compare Shannon indices (see Magurran 1988). The Morisita-Horn Index allows for comparisons between baseline and time series results (see Magurran 1988).

In addition, a habitat profile can be developed through a Habitat Diversity Index using Shannon calculations *(insert citation for methods of index)* for the area surveyed. A map characterizing habitat types, diversity, and coverage across the managed area and within the MPA can be built from the results of this analysis. Changes in habitat composition through time can be monitored using these results, and results can be compared against previous spatial data (if possible, overlaid using geographic information systems) to determine the location, extent, and degree of observed habitat change underway.

Characterization of the relative abundance of species within the community can optionally be identified as either log-normal, broken stick, or ecological dominance. Distribution of these patterns of relative abundance can be plotted and analyzed. These analytical methods are well documented in the literature; a useful reference is *(insert simple citation)*.

Discuss results between indices across and between habitats and communities sampled. What patterns in local and regional diversity can be elucidated? How do communities compare relative to the species that are found there and their abundances? Are there any changes observed through time regarding the relative abundance of native versus invasive species, and if so, what correlated changes in species richness and abundance are observed with the presence of these invasive organisms?

Based on the community composition (i.e., species diversity in terms of richness) data collected within and outside the MPA and the resulting evidence generated, choose and record the most appropriate rank from the following list to 'score' the community composition indicator for the time period in question.

1 – Data suggest that the community studied within the MPA is **experiencing a notable decline** (absence of more than three species and/or decline in the relative abundance of several species) in terms of its diversity
2 – Data suggest that the community studied within the MPA is **experiencing a decline** (absence of one or two species and/or decline in the relative abundance of a few species) in terms of its diversity
3 – Data suggest that the community studied within the MPA **remains unchanged** (no noticeable change in the number and/or relative abundance of observed species) in terms of its diversity
4 – Data suggest that the community studied within the MPA is **experiencing an increase** (presence of one or two species previously absent and/or increase in the relative abundance of a few species) in terms of its diversity
5 – Data suggest that the community studied within the MPA is **experiencing a notable increase** (presence of more than three species previously absent and/or increase in the relative abundance of a several species) in terms of its diversity

Based on the community structure (relative abundance, dominance shifts, and physical distribution) data collected within and outside the MPA and the resulting evidence generated, choose and record the most appropriate rank from the following list to 'score' the community structure indicator for the time period in question.

1 – Data suggest that the community studied within the MPA is **experiencing a notable shift** (large shifts away from normal structure in relative abundance or dominance) in terms of its structure
2 – Data suggest that the community studied within the MPA is **experiencing a shift** (some shifts away from normal structure in relative abundance or dominance) in terms of its structure
3 – Data suggest that the community studied within the MPA **remains unchanged** (no noticeable shifts relative abundance and dominance) in terms of its structure

4 – Data suggest that the community studied within the MPA is **experiencing recovery** (shifts toward a normal structure in relative abundance or dominance) in terms of its structure
5 – Data suggest that the community studied within the MPA is **experiencing notable recovery** (large shifts toward a normal structure in relative abundance or dominance) in terms of its structure

Outputs:

- An indicator score (1-5) of composition and structure for the community evaluated
- List of the species and habitats composing the community
- Description of how these species and habitats are structured within the community
- Profile of the relative abundance of selected species present within the community
- Profile of species dominance
- Profile of species diversity (richness and evenness)
- Profile of habitat diversity
- Habitat composition/type map

Strengths and Limitations of this Indicator:

The basic methodological strengths and limitations of the *in situ* survey techniques identified here are described under Biophysical Indicators 1 and 2. Additionally, not all the habitat types need to receive the same survey effort. For example, coral reefs monitoring may be prioritized over seagrasses or other soft-bottom communities based on threat, value, and risk assessment.

An adequate understanding of changes in community composition and structure is critical to achieve optimal management and fully understand the extent of impacts that management interventions have on the environment concerned. Establishing empirical causality between community composition changes and/or stability and implementation of an MPA is notably challenging, but nevertheless critical to improving MPA use and replication should such causality be established.

This indicator is one of the more challenging biophysical indicators to undertake. The actual survey methods involved are relatively straight-forward and approachable with a modest level of training and experience. However, due to the indicator's scope of data collection, a thorough and comprehensive understanding of community composition and structure will require considerably increased staff time, effort, and financial resources beyond what is required for simply monitoring the abundance and structure of populations of selected focal species. Beyond data collection, this indicator also requires substantially increased analytical and interpretive complexity. With this complexity there is also a higher degree of uncertainty involved with accurately interpreting results and drawing valid conclusions. Given these increased requirements, there is the risk that this indicator may be identified by the evaluation team as a secondary priority in terms management effectiveness data collection when in actuality it is of primary importance to collect given the priority goals and objectives of the MPA.

It should also be noted that the comparability of community composition results between a managed area (i.e., within the MPA) against adjacent, unmanaged areas undergoing both natural and man-made change may be difficult to accurately interpret due to "shifting baseline" effects. This effect is where the extent of changes in the community structure and composition that would naturally occur within the MPA if it were not experiencing human management intervention are not detected or are confused as "reductions" in changes observed in adjacent, unmanaged areas. The consequences of this effect can lead to errors in interpretation and conclusions when comparing control and treatment (MPA) data.

[@@@ Insert a strength/weaknesses table with support from pilot site test results/feedback]

Example

[@@@ Example data to be inserted later from pilot site data collected]

Useful References:

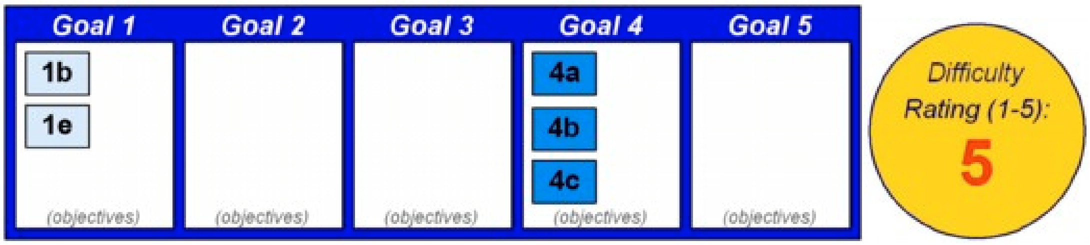
[@@@ All citations need finishing]

For how-to on calculations/indices:
Various biodiversity measurement references; online references
For stationary point-counts:
Samoilys 1997 Manual for Assessing Fish Stocks on Pacific Coral Reefs. DPI, Qld.
For randomized timed swims:
CI Rapid Assessment Program Methods
For line intercept and manta tow methods:
English, S., C. Wilkinson, and V. Baker, editors (1997). Survey Manual for Tropical Marine Resources. 2nd Edition. Australian Institute for Marine Science, Townsville, Queensland.
Magurran, A. E. 1998. Ecological Diversity and Its Measurement. Princeton University Press, Princeton, NJ.

[@@@ Insert references and online addresses for ecological statistics software]

[Insert URLs for these resources]

Biophysical Indicator 4: Recruitment Success within the Community



What is 'Recruitment Success within the Community'?

Recruitment success within the community is the degree of juvenile recruitment and survivorship experienced across populations of organisms that exist within a community. The degree of recruitment success is thought to serve as a proxy for the ability of the community to persist through time and be viable (i.e., the likelihood of continued persistence). Through the observation of changes in recruitment success, this may assist in describing how the relationships between populations in the community are or may be changing. This indicator therefore aims to provide some reflection on assessing the probability of a community of organisms being able to maintain itself through time.

This indicator is interested in measuring changes in the recruitment levels of multiple populations in a community so as to better understanding how the community is doing overall. It is not expected that recruitment success can be monitored for all populations occurring within the community. It is hoped that from collection of data for this indicator, MPA managers and other practitioners may improve their ability in predicting whether or not the diversity and amount of surviving recruits observed in the community indicate recovery of the community toward what it was prior to threat exposure, or whether or not the recruits indicate that the community is merely being maintained or perhaps being degraded. In this sense it is intended to be a dynamic indicator, serving as a forecasting indicator of trends occurring in the community rather than simply a 'snapshot' of how the community is composed and structured (Biophysical Indicator 3). However, recognizing the natural fluctuations in recruitment and seasonal population variability, the indicator must be considered in a long-term perspective.

This indicator aims to rapidly collect information on multiple populations of species (including focal species) within the community across the relevant habitat types or zones, as is not realistically expected that measurement of every population occurring within the community could occur. This indicator is focused on measuring the regularity (periodicity) and extent of general species larval settlement and recruitment as well as rates of juvenile survivorship within multiple populations in the community. It does not measure true reproductive capacity and viability. As the composition and relative abundance of species within a community is in part a function of a community's ability to replenish it's constituent populations, this indicator is closely related to and associated with *Composition and Structure of the Community* (Biophysical Indicator 3).

Why Should this Indicator be Measured?

While a community's composition and structure serve to provide a periodic or static understanding of the overall health and status of the community and its ecology, this indicator attempts to serve as a dynamic measure or proxy of a community's potential and ecological resiliency. For example, it is not enough to argue that a community is healthy and will be resilient based only on a stable and balanced community composition. Managers must also have some understanding of the potential for this community to persist, based on the regularity of spawning and recruitment events presence, an adequate abundance of recruits across populations to the community, and survivorship of an adequate number of these recruits to adult sizes. In this regard, this indicator is a community-level corollary to *Focal Species Population Structure* (Biophysical Indicator 2).

This indicator is sometimes used as a proxy for ecosystem health and food web integrity and therefore has important meaning for managers who are concerned with maintaining ecosystems function and resiliency through MPA use.

What Is Required to Measure the Indicator?

Data for this indicator can be collected concurrently within the surveys undertaken for Biophysical Indicator 2 (*Focal Species Population Structure*). In this regard, the requirements to undertake such surveys are similar. However, this indicator requires additional information and skills to that of Biophysical Indicator 2.

Additional informational requirements to collect this indicator include:

(1) Knowledge of larval settlement stages and recruitment areas for juvenile representatives of the community; and
(2) Knowledge of the breeding event seasons (timing) and spawning locations;
(3) An understanding of basic oceanographic patterns and processes in order to assess effects on larval import and export, which can be done relatively simply using dyes or simple drogues.

The necessary equipment to undertake non-specific collection surveys of juveniles and recruits at known settlement/recruitment areas within the community is also required, including trawl, seine, and gill nets. Note that these survey techniques should be done carefully as they can be highly destructive.

Data collection for this indicator is best undertaken by a specialist who adequately understands reproductive biology and recruitment processes within the resident system(s). If such a person is not available from within the MPA management team, universities and research centers may be able to develop a partnership to make such individuals available for data collection and training of MPA staff in survey techniques. Such a specialist will understand the additional equipment and skill requirements.

Additional time and energy (labor) will also be necessary to undertake broad size class and recruitment study across all members of the community, as opposed to just for a handful of selected focal species.

More advanced biological studies of breeding (reproductive biology) or spawning (reproductive behavioral) potential are also possible to gauge this indicator, although they will require significantly more labor, finances, and time than studies of size class and juvenile settlement and recruitment study patterns.

How Are Data Collected on the Indicator?

Recruitment success can be determined from the following parameters: (a) the presence and relative abundance of relevant size classes (recruits/juveniles and reproductive adults) of populations within the community, (b) the breeding or spawning potential and event regularity, and (c) the settlement and recruitment potential and event regularity.

The recommended minimum data collection for this indicator is the capture of size class information of focal species surveyed within and outside the MPA. The survey methods used to sample species (relative abundance and size classes) across the community are the same as those described for *in situ* survey under *Focal Species Population Structure*, Biophysical Indicator 2. Assuming some basic reproductive biology is known for members within the community, size class structure results may also serve to calculate the abundance of juvenile versus adult individuals across species within the community and begin to build a profile through time of survivorship rates of recruits and juveniles to adult stages. Generally speaking and holding all things equal, an adequate and stable number of surviving juveniles and reproductive adults across populations within the community will increase the community's ability to be viable through time. The collection of age structure data across all species within the community is not mandatory under this indicator, although some study may already be undertaken for the *Focal Species Population Structure* indicator.

Tracking the regularity and extent of known spawning and recruitment events should be undertaken under this indicator. Visitation at known spawning locations and estimation survey of spawning biomass should be attempted for focal species within the community. In addition, validation of the occurrence of these events should be evidenced through: (a) *in situ* collection of spawn (eggs and sperm) during and following known spawning events at aggregation sites, and (b) *in situ*, low-impact collection (e.g., light traps, collection plates/tiles, water column stations) of settling larvae and established recruits within known recruitment/settlement centers (e.g., mangroves and seagrass communities). Recruitment via asexual reproduction (e.g., fissure of soft-bodied invertebrates or coral reef fragmentation and grow out) is not measured under this indicator. Placement of small floats and drogues can assist in tracking water movement during and directly after spawning events to provide a sense of where the eggs and larvae are going. Current meters deployed in relation to tidal activity can be useful to make predictions about the timing of spawning daily or seasonally. Fixed visual census stations or timed swims (using either snorkel or SCUBA) can even be used to account for post-settlement juveniles when collecting other indicator (one through three) data, depending on the species and their life history. The use of trawl, seine, and gill nets to collect recruits/juveniles are destructive and may not likely not suitable for regular use under a sustainable monitoring protocol. The relative abundance and sizes of all species individuals (juveniles) captured in the recruitment survey should be recorded. The specific steps in undertaking a juvenile/recruit capture survey and spawning collection techniques are documented elsewhere in the literature (see English et al 1997 for a good starting point). Note that undertaking net capture of juveniles using nets will likely lead to high levels of indiscriminant (non-specific) mortality. While more sophisticated larval settlement and recruitment studies are possible, they are time and labor intensive and therefore are not considered minimum requirements to capture this indicator. References for identification of larvae and post-larvae are listed at the end of this indicator.

Viability data (at a minimum, size class information) should be captured at least annually and ideally timed with the *Focal Species Population Structure* survey. Timing of data collection will depend largely on the known timing and frequency of spawning and recruitment events.

Where possible, data collection under this indicator should be tied to the data collection undertaken on populations of focal species (Biophysical Indicators 1 and 2).

Note that fish aggregation and spawning sites often occur at discrete locations that may or may not be included within the area delineated by the MPA. If a known site is located adjacent to the MPA or in the general area, it will be important to be monitored as fish within the MPA may likely migrate to the aggregation site at certain times during the year to spawn there and then return back to home range territory within the MPA.

How Are Results Interpreted and Shared?

Collate, enter, and manage data gathered within the MPA effectiveness monitoring database. Create a community profile of the relative abundance of each population of species observed within the community and what proportion of observed individuals of each species are juveniles versus adults. Plot the relative abundance (y-axis) of juveniles versus adults (x-axis; using size class data to dichotomize) across species observed and sampled within the community. Are there a more or less juveniles and reproductive adults present across the represented populations than observed previously (see ranking, below)? Cross reference these findings with *Focal Species Population Structure* results generated. Track the age structure (juvenile versus adult) and relative abundance of species observed through time. Write up results and interpretation for public dissemination. Orally present results visually (graphs and tables) and discuss with selected stakeholder groups, decision makers, and peers. Encourage independent validation of results by outside parties within the sampled area in order to confirm or reject findings and improve the understanding of the effects of management action on the area. Be sure to include any stories or anecdotes that illustrate the results observed from stakeholders. Describe qualitatively (low, unpredicted, or high) and/or quantitatively (probability based on reproductive potential across species within community) whether or not the community is viable into the future. If not, how can these results inform adaptive management decision-making to address these concerns.

Finally, present the relative abundance (number/density) results of recruits and juvenile sizes resulting from the recruitment survey and discuss how these figures compare to previous observations.

Based on the size class structure and relative abundance data collected from populations within and outside the MPA and the resulting evidence generated, choose and record the most appropriate rank from the following list to 'score' the indicator for the time period in question.

1 – Data suggest that the presence of surviving recruits in populations studied within the MPA are **experiencing a notable decline** (reductions in the number of recruits across a majority of the populations studied) in the community
2 – Data suggest that the presence of surviving recruits in populations studied within the MPA are **experiencing a decline** (reductions in the number of recruits across a minority of the populations studied) in the community
3 – Data suggest that the presence of surviving recruits in populations studied within the MPA are **remains unchanged** (only minor or no changes in the number of recruits across the populations studied) in the community
4 – Data suggest that the presence of surviving recruits in populations studied within the MPA are **experiencing growth** (increases in the number of recruits across a minority of the populations studied) in the community
5 – Data suggest that the presence of surviving recruits in populations studied within the MPA are **experiencing notable growth** (increases in the number of recruits across a majority of the populations studied) in the community

Next, based on the results from data collected choose and record the most appropriate rank from the following list for the time period in question.

1 – The timing, frequency, and output of observed spawning and recruitment events has **decreased**.
2 – The timing, frequency, and output of observed spawning and recruitment events **remains unchanged**.
3 – The timing, frequency, and output of observed spawning and recruitment events has **increased**.

Outputs:

- An indicator score (1-5) for the level of recruitment success within the community evaluated;
- An indicator score (1-3) for the spawning and recruitment events timing;
- A community profile of the relative abundance of recruits/juveniles to the community following known larval settlement and juvenile recruitment events;
- A summary profile of the contribution of immature (juvenile) versus mature (reproductive adults) size classes to each species observed within the community;
- A confirmation on the frequency of known spawning events and estimate of spawning biomass;
- An estimate of the reproductive potential and resiliency of the community in the near future; and
- A profile of the biomass of eggs, sperm, and larvae released during such events.

Optional outputs may include:
- Age class structure (through otolith analysis) across populations of species present within the community;
- A profile of the reproductive potential (including spawning success and estimate of reproductive output) of species present in the community; and

- An improved understanding of the reproductive biology and spawning behavior for species within the community.

Strengths and Limitations of this Indicator:

Collection of this indicator will require considerably more time, skill, equipment, and financial resources to complete than merely focusing in on the viability of a few focal species.

Moreover, the indicator requires that disturbance collection surveys be undertaken that are different than those suggested elsewhere in the biophysical indicators.

Finally, results of juvenile recruitment rates and spawning regularity may not provide for a complete or accurate analysis of the reproductive potential within a community of organisms.

All this being said, this indicator is the closest suggestion for managers of how to encourage a more complete understanding of the dynamic nature of community ecology and reproductive potential.

[@@@ Insert a strength/weaknesses table with support from pilot site test results/feedback]

Example

[@@@ Example data to be inserted later from pilot site data collected]

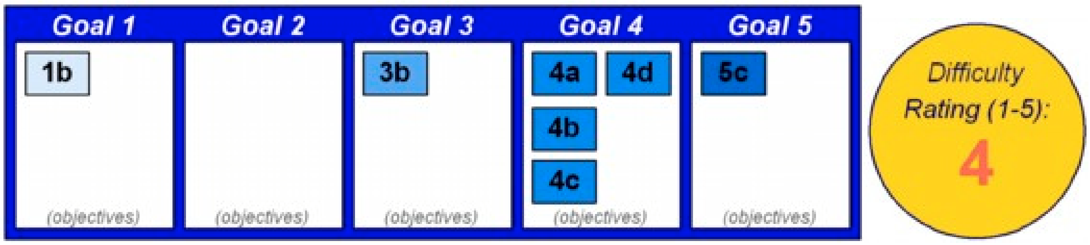
Useful References:

[@@@ All citations need finishing]

English et al 1997
Leis, Jeff et al (3 larvae & post-larvae id books)

[Insert URLs for these resources]

Biophysical Indicator 5: Habitat Distribution and Complexity



What is 'Habitat Distribution and Complexity'?

Habitat is the living place of an organism or community of organisms, characterized by its physical and biotic properties. Habitat distribution within a specified ecosystem is the spatial characterization of all habitats present based on their physical location (including depth) and configuration (placement next to one another), their extent (in terms of area in km^2), and composition (diversity) of the different types of species and substrate that form the zones of living space present therein. Therefore, the distribution of habitats and habitat types within a MPA depends on the physical and biological (community) characteristics of the living space contained within the MPA. For example, within nearshore tropical marine environments there often occur highly generalizable zones of habitat that are distributed by depth and substrate type from onshore out to deeper coastal waters including: (a) intertidal rocky shore and sandy beaches, (b) seagrass meadows and mud flats, (c) coral reef zones including the back reef flat, spur-and-groove reef channels, reef crest, and fore reef slope, and (d) lagoon and barrier islands and reefs. Some small MPAs may contain only one or two habitat types, whereas other MPAs may span large areas and whole ecosystems, containing dozens of habitats distributed throughout.

By characterizing the distribution of habitat types, MPA managers and practitioners can periodically assess the locations of and extent between (area) various habitat types to determine whether or not their distribution is changing, and if so, to what degree. By assessing the degree of change observed in how habitats are characterized (composition of species) and distributed throughout a MPA, managers and other practitioners can begin to gauge whether habitat complexity is increasing or decreasing, and whether or not this is an indication of changes the area's overall health. Habitat complexity can be defined and measured as the extent (area in km^2) and diversity (number) of habitat types and distinct zones. Higher complexity may not necessarily indicate a healthier ecosystem; the 'right' level of complexity all depends on what would occur naturally in the absence of human impacts. However, a highly complex habitat hosts a wider variety of habitat types and zones within the ecosystem in question in comparison to that of a simple structure which is uniform throughout and therefore may host a higher diversity of populations and focal species.

It is important to note that habitat complexity within MPAs and ecosystems do not always remain static through time under natural conditions. What is important to better understand is whether changes observed are due to naturally occurring ecological adjustments and succession or have occurred as a result of human perturbation. A highly complex coral reef ecosystem, along with its various zones and habitat and micro-habitat types, may naturally experience changes in the amount of algal-dominated reef flats versus live coral-dominated reef habitat areas. However, a prolonged and dramatic annual reduction in live coral reefs in exchange for increased algal-dominated reefs may be an indication that habitat complexity is in decline due to human impacts. An analogous example of habitat complexity within tropical moist forest ecosystems is that of an old-growth, 'climax' forest community where the species density is high and a diverse distribution of habitats and micro-habitats occur from the tallest, high-canopy trees to other sub-canopy and forest floor zones in comparison to an abandoned oil palm tree farm (in place of the original habitat) where habitat complexity may be characterized as comprising of a single species of one to two size classes only and only a few habitat types. The distinction in habitat complexity in both examples tells us something about the ecological changes that are occurring in both scenarios and allow managers to predict and inform future actions.

This indicator is focused more on identifying the types and delineating the distribution (location) and extent (area) of habitats found within and outside the MPA area, rather than examining the dynamics occurring between various habitats. In this regard, the indicator is a static, 'snap-shot' view of the habitats present and less a predictor for what is going to happen between habitats. However, if the habitat complexity evaluated is found to approach what would likely occur under natural conditions at the same point in time (including if complexity is maintained through time pursuant with the MPA goals and objectives), this achieved or maintained level of complexity would be considered an indication of habitat integrity, or ability to persist and provide living space through time (a more dynamic measure). While directly measuring habitat integrity would be unrealistic to expect from MPA managers and practitioners, documenting trends in complexity change may serve as a useful proxy for practitioners on the integrity of their habitats managed. Decreased changes to habitat complexity may indicate the presence of a physical disturbance that is underway or recently completed, which in turn may serve as an early-warning signal that habitat integrity may be deteriorating. Equally, changes observed may also indicate that a desired level of complexity is being achieved as a result of complexity recovery following a disturbance that has reduced/changed such complexity. Examples of disturbance events that lead to a reduction in complexity are cyclone and storm impacts, bottom trawling, or the impacts from use of destructive fishing gears such as dynamite, cyanide, and nets.

It should be noted that this indicator has links to large-scale ecosystem assessment, and therefore is a particularly useful indicator for larger MPAs that are representative of or include large-scale ecosystems.

Why Should this Indicator be Measured?

The *in situ* community and its constituent populations of organisms are all dependent on the presence of adequate living space within which to exist and reproduce. Declines in habitat complexity and integrity are well documented as being correlated with reduced community composition and species abundance and population structure. It is not surprising that habitat 'health' – i.e., structural integrity and viability – is considered a critical determinant to MPA success and is deliberately built into many management objectives in their use. In fact, this indicator relates closely to all five of the MPA biophysical goals identified, particularly to goals four (conserve habitat) and five (restore degraded areas).

The complexity and integrity of the habitat structure present is an important characteristic of most MPAs, particularly within MPAs that include or are representative of large-scale ecosystems. Understanding the status of and changes (particularly deleterious effects) in habitat complexity and structure is critical as characterize management needs and are often used as key determinants to delineate the boundaries of MPA use and prohibitive zoning therein (e.g., no-take areas versus limited-use areas).

What Is Required to Measure the Indicator?

The basic requirements in undertaking surveys for this indicator are listed under Biophysical Indicators 1 and 3: *Focal Species Abundance* (for assemblages of benthic organisms that comprise habitat*)* and *Composition and Structure of the Community* (in identifying habitat types, zones, and percent coverage). Beyond these, measurement of this indicator also entails several additional requirements.

Because all of the habitat types within and outside the MPA area must be identified, surveyed, and delineated so that their distribution can be characterized, a comprehensive habitat profile under this indicator is needed. This will require expanded time, effort (advanced human expertise), and financial resources, particularly within larger communities and MPAs that host highly complex habitat structures. GPS, GIS, and remote sensing technologies are expensive and require suitable staff experience and maintenance in order to be of use to the evaluation team.

Further, surveyors must have some familiarity with habitat types/zones, ecotones, and habitat structure in order to recognize and accurately delineate the ‘normal’ endpoint where one benthic assemblage ends and another closely related but distinct type begins. Next, these surveyors must have an understanding of what normal disturbance regime within a given community exists and how it would be manifested in comparison to human-induced disturbance impact effects. Project access is strongly recommended to an experienced community ecologist or habitat specialist who is willing to work with the MPA team and who is comfortable and familiar with the concept of seascapes as being comprised of patterns of habitat and a dynamic biotic patchwork mosaic with the characteristic patchiness of temporal variability.

This indicator is essentially a mapping and characterizing exercise of habitats present within and outside the MPA. As such, it is heavily reliant on the ability of the evaluation team to not only complete the *in situ* or remote sensing observation and measurement of habitat types within and outside the MPA, but also to then use these results to delineate the location (on a map) and extent (total area in km^2) of habitats present. The availability of suitable base maps (ideally, digitized) of the MPA area is therefore essential, as well as the field use of handheld global position systems (GPS) and office use of geographic information systems (GIS) technologies and software are necessary for this indicator. In larger MPAs, remote sensing (e.g., *ex situ* mapping though satellite imagery and/or aerial photography) technologies may also be necessary in lieu of or in addition to *in situ* survey and mapping.

The use of distribution and complexity of habitats as an indicator requires that the evaluation team also have a basic understanding of how focal species utilize habitat(s) and the patterns in such utilization. As a result, in the absence of sufficient baseline information on focal species and their habitat utilization patterns this indicator is best measured concurrently with Biophysical Indicators 1 and 3: *Focal Species Abundance* (for assemblages of benthic organisms that comprise habitat*)* and *Composition and Structure of the Community* (in identifying habitat types, zones, and percent coverage). In addition, *Focal Species Population Structure* (Biophysical Indicator 2) and *Recruitment Success within the Community* (Biophysical Indicator 4) are complementary indicators to this indicator, and may be undertaken in tandem with this it's measurement.

While the survey methods are relatively straight-forward, as a result of the combined technological, financial, and human resource requirements, this indicator is one of the most cumbersome and resource-intensive indicators to collect and may be out of the reach of many smaller, leaner MPA operations. Additional high-end technical options in capturing similar data for this indicator do exist. However, these require access, skills, and familiarity with expensive television, robotics, and video-grammetry technologies that are often not present or financially or technically sustainable within a modest MPA management team operating under budgetary constraints.

How Are Data Collected on the Indicator?

The *in situ* survey methods to identify and delineate the habitat types (and species) present are previously described under *Focal Species Abundance* (Biophysical Indicator 1) and *Composition and Structure of the Community* (Biophysical Indicator 3). These methods used in classifying assemblages of benthic organisms under these two indicators can also be used for this indicator to identify, characterize, and delineate (on a map using a handheld GPS) the various habitat types present and their structure and zonation across the MPA site. These surveys should measure the dimension (height, area, dimension) of assemblages of fixed sessile benthic organisms that create habitat complexity. By using a stratified or randomized sample of observation stations throughout the designated survey area (inside and outside the MPA), ratings or aerial estimates of recovery can be made through time. At each observation station, use transects, quadrats, or point-counts to estimate of the percent live cover (m^2), size frequency distribution (to estimate biomass), or density of benthic organisms observed. Use a GPS to delineate observed habitat types and zones within the area surveyed and digitize these results using GIS software on a project area base map in order to spatially display and analyze the distribution and extent of habitats present.

Next, to begin describing the progressive status in each habitat type observed and distributed across the MPA area, assign both: (1) a value of habitat quantity (e.g., percent live area cover in km^2, density ($\#/m^2$) or volume (g/m^2 biomass) of leaf litter generated, or total basal area in km^2 – see the bioconstruction index under Done and Reichelt 1998 for more details), and (2) an ordinal ranking of habitat quality: 1-5 scale from "degraded" (lowest), to "deteriorating", to "stable", to "improving", to "ideal" (highest). Compare these values with previous values observed in the area and overlay changes spatially using GIS software. Track changes in habitat distribution and diversity by overlaying the spatial extent of known threats operating in the area. Aerial photography and satellite imagery (which may be available off the internet from one of more government agencies) can serve to ground truth observations and will likely complement *in situ* survey results if such remote sensing technologies and available to the team. Alternative habitat profiling technologies including side-scan and bottom penetrating sonar, multibeam bathymetry and echo sounding, and bottom sampling may also serve useful in deep waters where *in situ* observational survey techniques may not be feasible.

A characterization of the complexity should be made both in terms of diversity (the total number of distinct habitat types or zones present) and degree (total area of each type in km^2 and a qualitative assessment of complexity as simple, moderate, or complex) regarding the habitat structure present. These characterizations may need to be made discretely for separate habitat types depending on the structure present and inter-dependencies of the constituent parts.

Comparison of these values through time and across habitat types (in km^2) can indicate the successional, degradive, or recovering status that the habitat is undergoing as well as highlight any potential trends or problems in habitat quality and quantity change.

Finally, estimate the integrity of the habitat structure and complexity value quantitatively (as the incremental change in difference, plus or minus, in area and values observed between present and previous occasions or the percent probability of viability scored as the difference from 100 in observed percent change) and/or qualitatively (as a description or estimated distance in percent of how far away observed habitat health and overall structural complexity is from what would be likely encountered under natural conditions. Describe any observed habitat fragmentation and characterize the impacts. These integrity estimates may require oversight or validation by a community ecologist familiar with the system and knowledgeable in terms of the influence that the conditions independent of human action would have on the surrounding environment.

Attempt to explain any observed reductions in complexity and integrity based on stakeholder and user group interview responses and documented disturbance events. Attempt to characterize such events in terms of their extent (area), intensity, and frequency. Cross-reference these observations against treat reduction assessment results captured under Biophysical Indicator 10, *Area Under Reduced Human Use/Impacts*.

Data collection frequency may depend on the growth and phenology (reproductive timing) of living habitats when their measurement is in question. Therefore data collection timing for abiotic habitats (rocky bottom, stone, mud floor) may be dependent on the biotic habitats present (kelp forests, corals, seagrasses, mangroves). Monitoring of habitat with annual or perennial life histories may require more frequent observation. As a rule of thumb, readjustment or refinement of habitat quantity and quality and type/zone delineation and complexity ideally should occur between every year to every three years (maximum five years), as well as following known disturbance events. Update the delineated habitat types/zones on the project map as necessary.

Finally, the data collection methods described here may be unsuitable and/or infeasible at some MPA sites. In these cases, simple underwater visual surveys (snorkel or SCUBA) and surface surveys to provide reasonable (even qualitative) estimates of habitat cover, diversity, and quality at sampling locations are better than no data collection attempt. Similarly, using a compass and land and sea markers, rough estimates for the distribution and extent of habitat types within the MPA area can be made by hand on photocopied maps. Such simple, low-tech habitat characterization and mapping methods are presented in guides referenced at the end of this indicator.

How Are Results Interpreted and Shared?

Results from this indicator should be: (a) written up as habitat type and distribution characterizations, and (b) delineated spatially in terms of the distribution (location) and extent (area in km^2) of habitat types within and outside the MPA on a base map of the project area. This will realistically require the use of GIS to digitally store, analyze, and display the spatial information gathered and overlay habitat complexity and quantity/quality results through time. A table of the total area for various habitat types and habitat complexity should be kept and updated annually or every two years. Updated delineation of the various habitat types, zones, and the overall structure on an annual basis will allow for comparison and monitoring of changes in the extent and complexity of habitats.

Results from data collection and analysis under this indicator can be linked to *Area Under Reduced Human Use Impacts* (Biophysical Indicator 10).

As further evidence of habitat integrity, explore correlating results from *Focal Species Abundance* of known indicator species (e.g., chaetodontid fishes) against the results of percent habitat cover (e.g., live coral reef cover) collected under this indicator and/or *Composition and Structure of the Community* (Biophysical Indicator 4). Note whether or not there is any strong correlation noted between these two sets of results. If not, discuss why this is. References for known indicator species of habitat quality and integrity are included at the end of this indicator.

Based on the data collected on the distribution and extent of habitats within and outside the MPA and the resulting evidence generated, choose and record the most appropriate rank from the following list to 'score' the indicator for the time period in question.

1 – Data suggest that the complexity of habitats studied within the MPA is **in notable decline** (reductions greater than or equal to 20% in area and/or "degraded" quality of habitat).
2 – Data suggest that the complexity of habitats studied within the MPA is **in decline** (reductions less than 20% and greater than 5% in area and/or "deteriorating" quality of habitat).
3 – Data suggest that the complexity of habitats studied within the MPA is **unchanged** (no change or reductions less than or equal to 5% in area and/or "stable" quality of habitat).
4 – Data suggest that the complexity of habitats studied within the MPA is **improving** (increases less than 20% and greater than 5% in area and/or "improving" quality of habitat).
5 – Data suggest that the complexity of habitats studied within the MPA is **improving notably** (increases greater than or equal to 20% in area and/or "ideal" quality of habitat).

Outputs:

- An indicator score (1-5) for the habitat complexity evaluated;

- A profile of the habitat types, zones, and structure present within the site and MPA including quantity, quality, complexity, and integrity estimates
- A map of the observed habitat types and zones, including their location and extent, delineated using GPS and GIS and overlaid with operating threat information.
- A spatial analysis of the extent of change in habitat distribution and complexity through time.
- Proxy measurement(s) for habitat integrity.

Strengths and Limitations of this Indicator:

The principal limitation regarding this indicator is that data collection activities require sizable demands in terms of time labor, expertise, technologies (e.g., GPS and GIS), and financial resources. Therefore it may be unfeasible to fully undertake the indicator in many MPA locations around the world. Moreover, even if the necessary time and resources exist, the appropriate scale of resolution within which to detect often subtle or even overt changes in habitat quantity (area), quality, complexity, or integrity will require significant *in situ* survey effort and/or high-resolution remote sensing technologies. Finally, even if adequate coverage in the sample is provided, there may be insufficient power to explain changes observed.

[@@@ Insert a strength/weaknesses table with support from pilot site test results/feedback]

Example

[@@@ Example data to be inserted later from pilot site data collected]

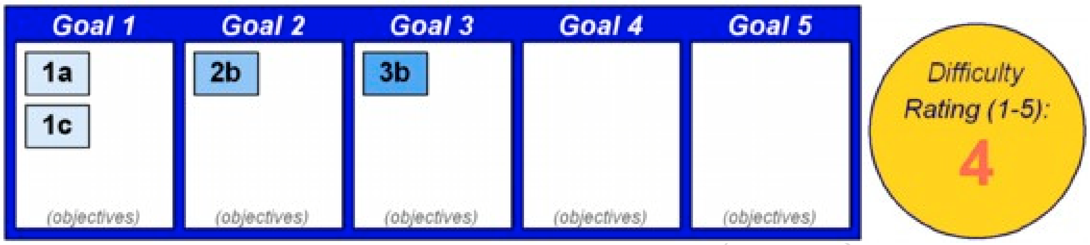
Useful References:

[@@@ All citations need finishing]

Done and Reichelt 1998 Bioconstruction Index
Karr, James et al Biotic Integrity Methodologies – habitat correlates
GIS of natural resources (How-To and Theory)
Ecological indicators of habitat quality and integrity
Low-tech habitat characterization and mapping guides

[Insert URLs for these resources]

Biophysical Indicator 6: Food Web Integrity



What is 'Food Web Integrity'?

A food web is a representation of the energy flow through populations in a community. The 'web' of relationships within this representation illustrates the many distinct but interconnected food chains, or linear sequences of organisms that indicate prey item and predatory relationships among them. A small proportion of the energy stored by the biomass within a position in the food chain is passed on to the next trophic level (position in the food chain) when this biomass is consumed. Food web integrity is a measure of how supportive (for the members in the community) and reliable the trophic relationships are within the interconnected food chains of a community. When a food web looses its integrity, it indicates that the relationships between trophic levels have been disturbed or lost. This may occur, for example, if a species within the food web is eradicated through over-harvesting, thereby changing or eliminating the feeding relationships that were dependent on its position in the food web – that is, elimination of its influence on prey items and removal of its biomass for those predators which relied on feeding on it. It is important to note that even if a food web is stable, it does not necessarily mean that it is supportive of the overall community or is a desirable state of predator-prey relationships.

Trophic position in a food chain is a functional classification and is not determined by taxonomy (although phylogeny can be used to make predictions about trophic function). The trophic relationship concept allows for a hierarchical perspective to emerge within community ecology. At the most basic level, individuals hold positions within food webs either as producers (photosynthetic organisms) or consumers. Consumers can be further categorized as either herbivores (feed on producers), carnivores (feed on herbivores and/or other carnivores), or detritivores (feed on decomposed or decomposing organic matter). In turn, groups of individuals within the same trophic position form functional 'guilds' within the community (e.g., herbivorous fishes, or apex predators). Finally, the network or 'web' of functional guilds and food chains culminates in a mass balance of energy exchange and biomass that comprises an ecosystem. It is at this highest level, where the energy exchange and biomass contained within the ecosystem is manifested within a food web, that this indicator seeks to assess and monitor.

Why Should this Indicator be Measured?

Describing the food relationships between populations in the community is an essential feature in the management of any MPA. A healthy and stable ecosystem is one that is able to sustain the energy flow between trophic levels within a food web. When positions in the food web are eliminated (such as from overfishing), trophic relationships are lost or jeopardized and the ecosystem may experience imbalance and negative cascading effects throughout the food web. Measuring, understanding, and monitoring such changes through time are an important need in assessing the impacts of effective MPA management in coastal ecosystems. Also, detecting changes in trophic relationships and observing reductions in food web integrity may serve as an 'early warning' signal for managers to predict troubled trophic relationships, remedy deteriorating ecological conditions, and increase management efforts in the area. As such, it can be useful in diagnosing large-scale ecological variations.

One of the most important, potential services that MPAs can provide is re-establishment of natural conditions and predator-prey relationships. This indicator can be used to document important and complementary evidence toward the achievement of re-establishing such natural conditions, and can be a powerful tool in demonstrating and characterizing how these natural feeding relationships exist where (as often the case is) such baseline information is not available. Given that we understand only a few food webs in the marine environment, the potential for contributed knowledge is very important. This indicator therefore also aims to collect evidence of restored or strengthened food web relationships, not merely detect when food relationships are awry.

Detecting changes in food web relationships provides managers with the opportunity to highlight such changes publicly, investigate their source, and determine whether or not they are the result of activities occurring within or outside the MPA. In the case where changes are within the control or political and legislative influence of the MPA manager, this detection may provide an opportunity to reconcile or address the causes of change. In some cases however, food web changes observed within the MPA may be due to exogenous (outside) influences that are well beyond the control of the MPA managers and/or unrelated to the MPA goals and objectives. For example, increased predation on threatened focal sea otter populations in an MPA by orca may be identified as a result of overfishing of orca prey item fish populations hundreds of miles away from the MPA by purse seines. In such instances, the awareness of the changing feeding relationships due to outside factors may: (1) provide the manager with the necessary knowledge and protection against unjustified MPA performance criticism due to changes observed within the MPA, and more importantly, (2) an opportunity to lobby for reconciliation beyond the jurisdiction and goals of the MPA. In this sense, such outside influences on food relationships can help MPA managers illustrate how external, non-MPA related actions have direct effects on MPA management effectiveness. This can help managers identify how to distribute (or re-distribute) human, financial, and policy resources toward other external interventions in order to improve the health of the area being protected. This being said, it is important to determine the scale of the evidence collected under this indicator so that it is used to address only questions/issues relevant to the scale at which they are being asked/raised. Therefore, changes in food relationships that are the result of higher scales of ecological change (e.g., global climate change) are beyond the scope of the MPA or its ability to influence such relationships and should be identified as such.

Finally, in theory food webs possess characteristics allowing them to be considered excellent ecological descriptors (Winemiller 1990). As a consequence, food web integrity is considered an important determinant of ecosystem health and functionality, both of which are difficult parameters to concretely demonstrate. Illustrating a functional and resilient food web therefore may serve as a proxy for a healthy ecosystem.

What Is Required to Measure the Indicator?

This is not an easy indicator to measure, and can be quite time-consuming depending on the complexity of trophic relationships within the managed area. The same data collection requirements under Biophysical Indicator 1 also apply to capturing information for this indicator. The team will additionally need a set of scales or balances (measurements in grams) and a calculator. Team members must have a firm understanding of predator-prey relationships between populations occurring within and adjacent to the MPA.

A fundamental comprehension of mathematics (and ideally mathematical modeling) is important to have with MPA managers and practitioners interested in collecting this indicator. Furthermore, availability (even remotely) of someone to consult the project team who is familiar with the technique used and/or other, more complex mathematical trophic modeling approaches is strongly recommended in order to build team capacity to develop and run such models.

Should an evaluation team determine that it is important to measure this indicator at their MPA, the team should be aware that it will likely take some additional time to secure the necessary human and financial resources and develop the capacity to undertake this undicator.

How Are Data Collected on the Indicator?

Identify and aggregate the various organisms into trophic positions and guilds within the community food web; that is, assign organisms as either producers, herbivores, first-level carnivores, second-level carnivores, etc. within a set of interconnected food chains. From *in situ* capture and release or fish catch surveys, directly measure and record the average weight (g/m^2) and relative biomass of populations of organisms found within the community. Relative biomass (g/m^2/species) can be determined for each population by collecting the weight and size of individuals observed in addition to calculating the area from which these observations are taken. List average species biomass records by trophic guild in ascending order. This can be done either from a book of species with trophic guild membership that can be consulted or from baseline study of digestive tract contents found in the relevant species concerned. Next, identify the relative abundance (number) of organisms found within the area surveyed from data collected under Biophysical Indicators 1 and 3. From here, sum the relative biomass (g/m^2) of each trophic guild by the multiplying the average biomass of individuals in a population by the total number of individuals (abundance) observed within the trophic level. List the total biomass of each guild in ascending order, along with the constituent species making up the level. Note that in some cases (depending on the objectives of the MPA), managers may only be concerned with understanding food relationships between herbivorous and carnivorous species, and may focus data collection accordingly.

Because trophic relationships and structures vary widely by geography and community composition, biomass and abundance data must be collected (and analyzed – see below) at a site- or community-specific level. Data collection should occur annually or twice a year. An inter-annual time series data collection approach is recommended.

How Are Results Interpreted and Shared?

First, create an illustration of the assumed food web being represented within the community. Specifically, highlight distinct food chains of species observed and interconnections between these food chains. Also, identify and aggregate the various organisms into trophic positions and guilds within the food web: i.e., producers, herbivores, first-level carnivores, second-level carnivores, etc. Using the total biomass results obtained for each trophic guild observed within the food web, trophic ratios (or proportions) between guild levels can be determined and rankings assigned. The trophic ratio is the relationship of the biomass values among the different trophic guilds (e.g., the producer-herbivore ratio or the producer-tertiary carnivore ratio; Arias-Gonzalez 1998). Next, assign trophic levels as either integer (1, 2, 3…) or fractional (1.3, 2.7, etc. as determined thorough a weighted average of prey item trophic levels) rankings (see Lindeman 1942 and Odum and Heald 1975) across specific guilds within the communities present in the ecosystem(s). A good summary of the specific steps in how to go about this trophic level assignment is found in Christensen and Pauly (1992). A very simple trophic level index (TLI) could be calculated weighing both integer and fractional trophic level by the trophic guild biomass. For example, in a system that is characterized as 30% herbivorous (trophic level = 1), 40% first-level carnivorous (trophic level = 2), and 30% second-level carnivorous (trophic level = 3), the TLI will be: 1 (0.30) + 2 (0.40) + 3 (0.30) = 2.

Ecological efficiency is the percent of biomass produced by one trophic level that is incorporated into the biomass of the next higher trophic level. Generally speaking, this is approximately 10% of the total energy available within any one trophic level. Based on this rule, each trophic level that is assigned for guilds present is weighted 10 times the one below it. Of equal or greater importance may be that it reflects progress towards the stated goal of maintaining abundance and large size among species of high trophic levels. Create a table of the resulting values in order of increasing trophic assignment. Finally, calculate a trophic structure index using the summary results generated to this point (see Done and Reichelt 1998, Christensen and Pauly 1992).

Observe changes and shifts in trophic structure/position and the index through time. Determine (based on index results) whether or not the food web observed is stable, in decline, or improving. Use observed results to predict trophic trends and inform management decision-making and priority setting.

Rigorous ecological study and advanced modeling will be necessary to confirm or reject with confidence the results of this indicator. It should be noted that numerous, more advanced mathematical modeling techniques exist and are available to managers through which to gauge the stability and reliability of trophic relationships found within the target ecosystem. For example, some models allow managers to predict the effects of species exploitation at varying levels of maturity on the overall food web. For the purposes of meeting this indicator such advanced modeling techniques is not required, as it may not be feasible for the MPA project team to undertake them.

Based on the data collected on the food web relationships within and outside the MPA and the resulting evidence generated, choose and record the most appropriate rank from the following list to 'score' the indicator for the time period in question.

1 – Data suggest that the food web within the MPA is **undergoing notable deterioration** (shifts away from the desired state in trophic relationships greater than or equal to 30%).
2 – Data suggest that the food web within the MPA is **undergoing deterioration** (shifts away from the desired state in trophic relationships less than 30% and greater than 5%).
3 – Data suggest that the food web within the MPA is **unchanged** (no change or shifts in trophic relationships less than or equal to 5%).
4 – Data suggest that the food web within the MPA is **undergoing restoration** (shifts toward the desired state in trophic relationships less than 30% and greater than 5%).
5 – Data suggest that the food web within the MPA is **undergoing notable restoration** (shifts toward the desired state in trophic relationships greater than or equal to 30%).

Outputs:

- An indicator score (1-5) for the state of trophic relationships evaluated
- An illustration of the food web and interconnected food chains therein
- A profile of average species and relative biomass, grouped by trophic guild
- A profile of total biomass within observed trophic guilds
- A list of trophic ratios between guilds to be monitored through time
- A trophic structure index

Strengths and Limitations of this Indicator

The collection of data for this indicator builds seamlessly off of existing data collected and surveys undertaken for Biophysical Indicators 1 (*Focal Species Abundance*) and 3 (*Composition and Structure of the Community*). Incrementally, capture of data for this indicator appears at first-glance relatively straightforward given existing investments. However, this incremental time investment and the calculations involved will require much more than a trivial additional time and manpower investment. Based on previous application experience, even the simplest modeling of such food web relationships can become quite time consuming and labor intensive. Furthermore, this incremental information (weight) is not necessarily always relatively easily and quickly obtained and the comfort and familiarity with mathematics in the MPA team may not be apparent. Given the difficulties in collecting this indicator, evaluation teams need to think carefully about how closely justified data collection for this indicator is against the MPA goals and objectives.

However, this indicator has limited accuracy and poor inference beyond the sites and communities where trophic information is modeled. As we enlarge the level of our analysis of food web relationships our accuracy is decreased significantly. Further, establishing causality between trophic changes observed in the food web and use of management interventions (or the lack thereof) is not possible. Essentially the indicator is more of an important and illustrative tool of the state of the community ecology being managed more than an proven measure of management effectiveness.

Finally, assessment of food web integrity is accepted as an excellent macrodescriptor of the changes occurring within the ecosystem.

[@@@ Insert a strength/weaknesses table with support from pilot site test results/feedback]

Example

[@@@ Example data to be inserted later from pilot site data collected]

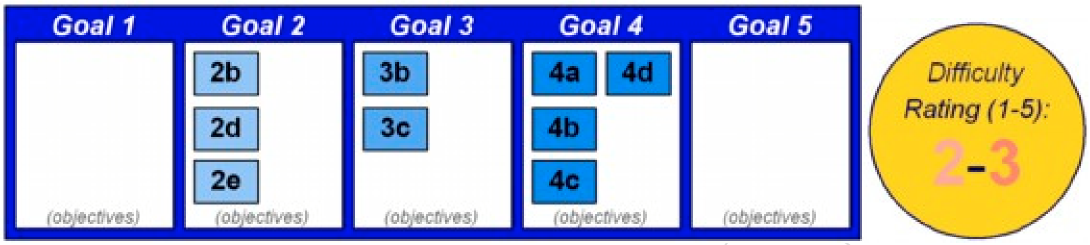
Useful References:

[@@@ All citations need finishing]

Arias-Gonzalez, J. E. 1998. Trophic models of semi-protected and unprotected coral reef ecosystems in the South of the Mexican Caribbean. *J. Fish Biol.* 53 (Supplement A): 236 – 255.
Christensen and Pauly 1992
Done and Reichelt 1998 Bioconstruction Index
Lindeman 1942
Odum and Heald 1975
Pauly et al Fishing Down Food Webs
Winemiller 1990

[@@@ Insert URLs for these resources]

Biophysical Indicator 7: Water Quality



What is 'Water Quality'?

Water quality is an abiotic and biotic (in the case of bacterial pollution) measure of the ambient environmental parameters present within the water column. Parameters of water quality include temperature, salinity, oxygen content, turbidity, sedimentation rate, nutrient loading, and presence (suspension) and density of toxins, bacteria, and other particulate matter.

Why Should this Indicator be Measured?

Water quality is a limiting factor to biological processes within the organisms, populations of organisms, and habitats present within the project site and MPA. Water quality is therefore a key determinant of overall community health and viability. As such, it is an important indicator to measure, one which will be necessary to maintain a respectable level of scientific credibility.

Water quality can be easily and negatively influenced through multiple sources of human activities in or near the coastal zone, particularly in terms of marine pollution. Some examples of human activities that negatively influence water quality include point and non-point discharge of human and other solid and liquid wastes, dumping of trash and refuse into the sea, oil and toxic spills within coastal waters, storm water run-off from urban areas, upland erosion of sediments and their transport and deposition/siltation on down stream coastal environments, fertilizer presence from agricultural run-off, and bilge water discharge.

One objective of MPA use is to protect coastal waters from or minimize the impacts of marine pollution and activities that are known to reduce water quality. This is particularly true for MPAs which contain habitat types that serve as land-sea interface areas, such as wetlands and mangrove swamps that act as important filters in mitigating marine pollution and maintaining an adequate level of water quality for the wider community and coastal ecosystems present within the surrounding areas.

This indicator should particularly be measured at MPAs with goals and objectives tied to tourism, diving, and other economic activities requiring high water quality. Further, MPAs with goals and objectives linked to improvement of water quality and water or waste management practices should prioritize collection of this indicator.

It should be noted that the link between effective MPA management and improved water quality may not necessarily be causal. However, it is assumed that through the designation and management of the MPA, in many cases this will include a reduction in known *in situ* activities that pollute the marine environment and/or changes in land-based activities that have downstream impacts on the marine environment. In such cases, an improvement in (or maintenance of) water quality over the long-term could be reasonably expected from effective MPA management.

Understanding the effects of land-based activities and water quality on the nearshore marine environment, focal species therein, and even human health can also have important public educational opportunities for redirecting social behavior related to marine pollution and waste disposal.

What Is Required to Measure the Indicator?

For most of the measures outlined below, relatively simple methods of water quality testing can be undertaken with some labor investment (2 to 3 persons) and an adequate commitment of staff time. This assumes that adequate staff training is completed in how to properly and efficiently use standard hand-held and laboratory water quality monitoring equipment (e.g., thermometer, refractometer, collection bottles for water samples, secchi disc, light meter, and laboratory equipment) and analyze data. Staff expertise in physical oceanography, or at least a firm understanding of currents and basic water dynamics, at the MPA site will be necessary.

In most cases, access to and assistance with the specialized equipment (e.g., instrumentation for analysis of phenol, heavy metals, and other toxics) necessary to undertake certain measures under this indicator will be available in-country to the evaluation team through partnership with Universities, government agencies, and/or other research institutions. In some cases, international assistance may need to be requested to analyze some complex parameters of water quality.

Equipment and training costs for the full suite of measures (outlined below) will require moderate to significant financial resources. More technical equipment and measurement does exist for evaluating water quality, but are likely not necessary to sufficiently profile this indicator.

Large-scale baseline environmental quality assessments and implementation of long-term monitoring protocols may require partnerships with outside environmental quality government agencies or academic institutions.

How Are Data Collected on the Indicator?

There is much written regarding how to undertake water quality survey within the coastal water column (at varying depths), and so these techniques are not repeated here (see references listed at the end of this section). However, the following parameters and measurements are recommended for collection under this indicator on a regular basis (weekly, monthly, or quarter-annually, depending on the parameter) across sampling locations:

(1) *Sedimentation rate*: use downstream sediment traps and measure particulate presence, composition, and suspension density (parts per thousand) from water samples taken; measure loads and changes in densities and attempt to identify sources;
(2) *Temperature*: use a marine-rated mercury thermometer in protective casing or inexpensive electronic probes; for longer-term deployment (particularly in known areas at risk to sea surface temperature warming), use submersible, retrievable temperature loggers whose data readings can be downloaded after a fixed period of time and then re-deployed.
(3) *Salinity and freshwater input* (particularly useful in sensitive estuarine habitat): use a durable refractometer;
(4) *Oxygen content*: a number hand-held electronic devices exist to measure dissolved oxygen content and monitor eutrophication areas;
(5) *Turbidity*: use a secchi disk at various sampling locations; and
(6) *Standard Water Analysis*: check for known pathogens such as *E coli*. (biological indicator), and screen for presence and measure loading rates (amount) of oil, petroleum, nutrients (especially nitrogen, phosphorous) and fertilizers, pesticides and other toxins, and heavy metals.

Scientific validation of findings and study trends (literature) that demonstrate relationship(s) between environmental (in this case, water quality) parameters and species and habitat abundance and viability is also needed over the long term to provide a firm understanding of causality. Therefore, the project will likely need baseline data on the history and trends of various environmental factors within the area. Also, accounting for natural perturbations (particularly related to water temperature and salinity changes) will be important to accurately gauge impacts related to management (inside the MPA) or unmanaged human use (outside the MPA). This may necessitate undertaking broader, long-term monitoring program of study through project partners in the government and academia. For example, monitoring upland agricultural development impacts including pesticide/fertilizer and nutrient loading in the watershed, estimating runoff volume and sedimentation rates may be necessary to fully understand and predict upper and lower limits of water quality parameters during certain times of the year (e.g., during the rainy versus dry seasons).

The seasonality of water quality (e.g., rainy seasons and frequency of river basin flooding) must be accounted for when considering an appropriate timeframe within which to collect such information.

More advanced evaluation of water quality and its links to the biotic system may also be useful to evaluation teams that have the necessary skills, time, and resources to undertake. For example, sampling for the presence and amount of persistent organic pollutants (PCBs) within the tissues of focal species may be an important activity to undertake at a MPA located downstream of upland agricultural activities given its goals and objectives. Or perhaps tracing the path and monitoring the levels of heavy metal bioaccumulation through various trophic levels of the resident food web is important to people living near an urban MPA who rely on local fishery spill-over from a no-take area for food and income.

Collection of data for this indicator can be linked to the collection of information related to assessment of Biophysical Indicator 10, *Area Under Reduced Human Use/Impacts*.

How Are Results Interpreted and Shared?

Summarize and disseminate results with resource users and stakeholders. Analyze the results generated in terms of two components: (1) identification of the water quality issues and specific parameters needing to be addressed, and (2) assessment of what is causing/sourcing these changes. In this regard, the scale-dependency of the parameters investigated become more evident.

Monitor observed changes and trends in the environmental parameters measured for water quality and disseminate findings. Correlate these findings against *focal species abundance* and *composition and structure of the community* results to see if any relationships or patterns emerge.

Encourage a community-organized water quality monitoring system to take responsibility for regular monitoring and analysis activities. Simple computer software packages (e.g., PRIMER ecological statistics) and the use of friendly, specific procedures to interpret water quality (e.g., the BIOENV procedure) could also be useful for community interpretation of results.

The seasonality of water quality (e.g., rainy seasons and frequency of river basin flooding) must be accounted for when analyzing and interpreting results.

Results should be reviewed by a water and environmental quality specialist on or available to the MPA evaluation team, and ideally independent spot-checking to confirm or reject measurements taken should be done by the specialist.

Based on the water quality data collected within and outside the MPA and the resulting evidence generated, choose and record the most appropriate rank from the following list to 'score' the indicator for the time period in question.

1 – Data suggest that the water quality within the MPA is **poor** (largely shifted away from the desired water quality state across the majority of parameters measured).
2 – Data suggest that the water quality within the MPA **needs improvement** (shifted away from the desired water quality state across a minority of parameters measured).
3 – Data suggest that the water quality within the MPA is **unchanged** (no change or only slight shifts away from the desired water quality state across a few of the parameters measured).
4 – Data suggest that the water quality within the MPA is **improving** (shifted toward the desired water quality state across a minority of parameters measured).
5 – Data suggest that the water quality within the MPA is **good** (largely shifted toward or is at the desired water quality state across the majority of parameters measured).

Outputs:

- An indicator score (1-5) for the state of water quality evaluated; and
- An index of water quality parameters

Strengths and Limitations of this Indicator:

The data collected under this indicator are easily collected and can involve trained community volunteers to complete them. The frequency within which these measures are taken necessitates a relatively high turn over in monitoring equipment, which can add up through time. However, because of the relative ease and important that this indicator carries as it relates to the biophysical environment (particularly in terms of abiotic factors), this indicator should be easily undertaken.

Water quality is a highly complex issue to address and control with many sources of influence that often arise from outside the jurisdiction and mandate of the MPA and its managers. In this situation, MPA water quality may be strongly influenced by on- and up-land development and environmental management practices that lie well outside the influence of the MPA team. For example, a MPA objective to improve water quality may be unfeasible based on poor upland agricultural practices that lead to downstream sedimentation and the introduction of fertilizers into the marine environment of the MPA. In such cases, the indicator can be used to highlight the extent and persistence of such problems by MPA managers to the public and with decision-makers. Also, MPA managers can use such opportunities to raise issues regarding the appropriate citing and design of the MPA.

Because it may be difficult to accurately or definitively link the water quality status at a MPA to the success or failure of the MPA to achieve the stated goals and objectives, in some cases it may be dangerous to claim a direct correlation between this indicator and ‘proof’ of effective MPA management. Despite this shortcoming, the measurement of water quality against stated MPA goals and objectives will be an important indicator to measure at many MPAs, and thus is being included in this guidebook.

This indicator is the only biophysical indicator focusing on ‘environmental’ conditions and basic monitoring of micro-scale and abiotic factors. This being said, it is recognized that red tide events, heavy metal and toxin bioaccumulation, eutrophication, and fish kills are all globally prevalent phenomena and linked to the types of parameters being assessed in this indicator. In this sense, the “weighting” of this one environmental indicator should not be considered equal or less than any other of the biophysical indicators. In the process of developing these indicators, several related environmental indicators were collapsed within this now umbrella environmental indicator. It may be that certain MPAs, given their goals and objectives, may desire to split the measures collapsed under this indicator into several discrete indicators (e.g., chemical and biological water composition, sedimentation and siltation, toxin presence).

[@@@ Insert a strength/weaknesses table with support from pilot site test results/feedback]

Example

[@@@ Example data to be inserted later from pilot site data collected]

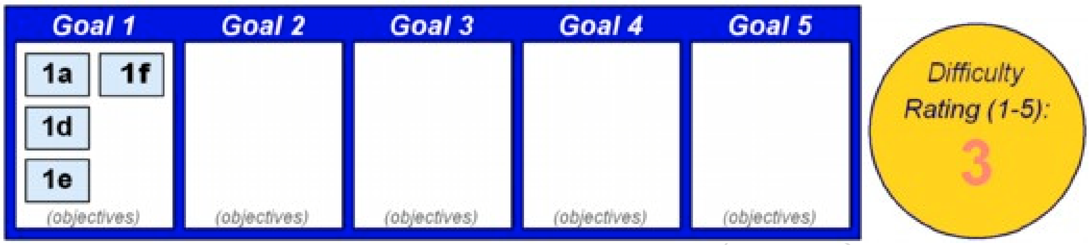
Useful References:

[@@@ All citations need finishing]

Water quality monitoring guidebook of standard methods
Theory and practice references

[Insert URLs for these resources]

Biophysical Indicator 8: Type, Level, and Return on Fishing Effort



What is 'Type, Level, and Return on Fishing Effort'?

The *type* of fishing effort is a description of the kind and degree of extractive power (in terms of both technology and skilled labor) used during fishing activities. "Fishing" is broadly defined here as including any extractive activity of living marine resources by people for commercial or non-commercial (e.g., subsistence) use. Therefore, "fishing" includes extractive activities from the harvest of fish and shellfish using boats and fishing gears to shallow-water gleaning or seaweed harvesting done by hand. While the principal focus of this indicator is to assess fishing effort related to catch sale (income generation) and food use (including subsistence consumption) adjacent to (or within) the MPA, the indicator can also be easily adapted to assess fishing effort related to recreation and sport fisheries.

The *level* of fishing effort is a measure of the amount of total labor (number of people) and time (number of hours/days) used during a fishing activity.

The *return* on fishing effort is a measurement of the efficiency with which the harvesting activity is undertaken. Efficiency in fishing effort is measured as the weight (biomass) of species caught per unit effort (hour or day; per person or team of people) harvest invested for each fishing method/technology used.

Catch per unit effort (CPUE) profiles of fishing activities should be completed inside (if relevant and ideally catch-and-release) and outside the MPA across the various fishing technologies/gears used within the area on a regular (several weeks per year) basis. These data must be either collected *in situ* during fishing operations or within a creel survey of catch landings when brought ashore.

Why Should this Indicator be Measured?

Many times MPAs are established explicitly because of the high importance that fisheries extraction has in sustaining human societies. Increased fishery yields (via spill-over of biomass from no-take zones and MPAs) and improved livelihoods (via improved income and food availability from increased fisheries yields) are therefore common and important objectives of MPA use throughout much of the world. This indicator is a direct attempt to quantify and track trends in fisheries yield, technological uses, and livelihood opportunities through time.

The measurement of this indicator is closely linked to *Focal Species Abundance* (Biophysical Indicator 1) and therefore is likewise considered one of the most important biophysical indicators. Increased CPUE is often observed as being correlated to increased focal species abundance. It is also indirectly linked to measuring spill-over effects from no-take areas (Biophysical Indicator 11), as well as being related to community structure (Biophysical Indicator 3) and trophic relationships (Biophysical Indicator 6) through the collateral effects of by-catch associated with some fishing technologies and/or the systematic removal of top predatory species from the community.

This indicator also has thematic ties to the socioeconomic and governance indicators relating to human uses of marine resources. In this sense, data collected for this indicator can be useful not only to other biophysical indicators, but also for improved socioeconomic and governance understanding in a MPA.

Despite the importance of measuring the impacts of MPA use on fishing catches, it is important to note that only in a relatively few cases has this type and level of analysis been done in the literature at MPAs.

It should be noted that while this indicator is focused on extractive activities, there are other non-extractive activities (e.g., tourism, diving, aquaculture) relating to a MPA's marine resources that may be important for the evaluation team to assess, including the level and rate of return (income) of such activities.

What Is Required to Measure the Indicator?

(1) Knowledge of the number of resource harvesters and their fishing activity;
(2) The amount of time (hours/days) each person spends harvesting resources;
(3) How efficient the technology is at catching the desired species;
(4) The physical impact (if any) of the fishing technology on the habitat; and
(5) Clearly designated list of locations for survey including access points and boat ramps into for entry into the MPA and key fishing locations at representative use sites for each type of use within the project area.

Measurement of this indicator is not as simple as it may appear, and the MPA evaluation team needs to be aware that accurate catch data collection for the predominant species (those caught most often) and for focal species (those of interest to the MPA and its goals and objectives) will require notable additional time and man-power. CPUE surveys also require relatively well-trained staff and must be done consistently for at least a full year in order to acquire an accurate idea of what catch rates are. Furthermore, scientific consultants and staff (who may need to be hired out and are expensive) will be necessary to develop catch-effort databases and analyze baseline data. Finally, CPUE data must be accompanied by comprehensive frame surveys that profile the power (boats, fishers, and gears) used across the effort (time) employed and that must be regularly updated.

To truly measure the return on fishing effort expended, this would require a sophisticated and broad level of fisheries independent data and more advanced analytical approaches than what is outlined under this indicator. However, through monitoring changes in the type of fishing power and the level of and return on fishing effort in an area the evaluation team can begin to develop an informed understanding relating to trends in fisheries extraction and how these trends are relates to the management of the MPA.

It should be noted that while this indicator is focused on extractive activities, there are other non-extractive activities (e.g., tourism, diving, aquaculture) relating to a MPA's marine resources that may be important for the evaluation team to assess, including the level and rate of return (income) of such activities.

How Are Data Collected on the Indicator?

Fishing effort is different for, and has a different effect on, every fish species. Therefore, measures of fishing effort – even in an ecosystem or community framework – must be species-specific. For example, it is not possible to club several species of grouper together within a single catch effort survey. Each species must be individually parsed out from the others, data collected specific to itself, and analyzed as such. This is important because in clubbing multiple species (for example grouper) together in a catch survey, this may inadvertently lead to the systematic extirpation of uncommon or rare species of grouper whose frequency of catch was masked by commonly occurring species of grouper. The rationale and logic to this method is well documented (Polunin and Roberts 1995, Russ and Sale 1991).

A set of simple and useful methods for measuring the type and level of fishing effort is described in the Learning Framework of the Locally Managed Marine Areas Network (2002). These methods are summarized here.

Basic catch data need to be collected regarding the marine resources removed by local stakeholders from the project site (and perhaps from within the MPA, depending on zoning). Much of this information should be collected by interviewing and working with resource harvesters. In particular, species composition, the size of individuals in selected species, the total weight of the catch (in kg), and the total value of the catch (in local currency) need to be captured and recorded. Changes in the size and composition of catch are as important or more important than how many fish are being caught.

Also, basic power (type of technologies used and number) data for local stakeholders need to be collected. In particular, the number of boats and fishers, the number and type of harvesting methods and gears used, the number of engines, size of boats, and types and numbers of other various harvesting technologies used all should be recorded. All of these data may be collected either through *in situ* fisher interviews or CUPE and catch landing (creel) surveys. The end of this indicator lists references that contain these survey methods.

National or local fisheries data available through governmental or non-governmental agencies may also provide a good source of data to triangulate with interview and CUPE/creel survey findings. In particular, licensing information of commercial and industrial fishing operations may be useful. Describing the trade and market attributes of the fisheries in question, including the market value and annual tonnage/value of catches, may also be feasible using government bureau statistics. These data should be triangulated with the relevant socioeconomic indicators.

In terms of level of fishing effort (efficiency), labor data must be collected in terms of hours or days fished. The specific steps used to undertake this in performing CPUE and creel surveys are well documented in the literature and are not repeated here (see references at end for suggestions). With the level of effort data collected, the evaluation team can calculate the catch per unit effort using the weight of key species caught per hour spent harvesting for each fishing method/technology. Results should include a description of fishing technologies used and their assumed potential for habitat destruction. If possible, estimates (covert if necessary) of the frequency of destructive actions such as cyanide fishing, dynamite fishing, and coral mining should be made.

Additional catch and effort data can be collected by asking and training harvesters to record their total catch and the time spent fishing for selected indicator species. A supplemental method is to interview harvesters during the household survey to determine approximately how often they go to harvest resources and what their typical catch is like.

One caveat is that differential interpretation of results may arise based on the life history of the population being fished and the timing of the catch survey done. For example, data may be skewed (false positive) to look as if a tremendous increase in CPUE is observed when in reality this is simply due to undertaking the landing survey at a time when fish migration, aggregation, or recruitment is underway.

Finally, estimates of the amount of destructive fishing effort present can be estimated by talking to key informants. Since destructive fishing techniques are often illegal, it may be difficult to get good estimates; project teams should carefully select their key informants and be aware of any potential biases (see IMA methods). Ask each informant to rank the prevalence of destructive fishing efforts using the following scale. Record any relevant stories or anecdotes.

1 = **constant** incidents of destructive harvesting techniques being used
2 = **frequent** incidents of destructive harvesting techniques being used
3 = **some** incidents of destructive harvesting techniques being used
4 = **limited** incidents of destructive harvesting techniques being used
5 = **few or no** incidents of destructive harvesting techniques being used

Record the descriptions of fishing technologies used and their potential for habitat destruction. Record rankings of the prevalence of destructive fishing technologies.

For several two-week periods each year (time with fishing seasons), a project team member should meet all returning resource harvesters and interview them about their catch and the effort expended. Creel interviews ideally should be randomly sampled with respect to the time of month, and comparison of full and new moon periods with first and third quarter periods can be undertaken during reproductive periods. If possible, try to collect data the same time of year from year to year. Harvesters should be encouraged to report their basic catch effort on a continuous basis. More intensive survey data should be collected every two years.

Based on the data collected for the level of fishing effort within and outside the MPA and the resulting evidence generated, choose and record the most appropriate rank from the following list to 'score' the indicator for the time period in question.

1 – Data suggest that the level of fishing effort around the MPA has **notably declined** (CPUE declines of greater than or equal to 30% in focal catch species).
2 – Data suggest that the level of fishing effort around the MPA has **declined** (CPUE declines of less than 30% and greater than 5% in focal catch species).
3 – Data suggest that the level of fishing effort around the MPA has **remained steady** (no CPUE declines or declines of less than or equal to 5% in focal catch species).
4 – Data suggest that the level of fishing effort around the MPA has **improved** (CPUE increases of less than 30% and greater than 5% in focal catch species).
5 – Data suggest that the level of fishing effort around the MPA has **notably improved** (CPUE increases of greater than or equal to 30% in focal catch species).

Outputs:

- An indicator score (1-5) for the level of fishing effort evaluated
- A record of basic catch and effort data about marine resources removed by local stakeholders across gears/technologies used;
- Estimated total amounts of catch of different species for the project site over a two-week period of time. These results can be plotted to observe trends on a simple graph; and
- A map of key representative fishing sites across habitat types in and outside the MPA; locations of key points of entry (parks, boat ramps) to the MPA.

Strengths and Limitations of this Indicator:

Data under this indicator are relatively straightforward to collect, although it may appear simpler than it really is and can often be time consuming and labor intensive. With sufficient training, CPUE and creel surveys can be undertaken by project staff and community volunteers for relatively little cost or logistical investment. However, technical oversight and scientific review of results by qualified and experienced fisheries biologists is important, and so the collection of CPUE data may not be appropriate or feasible in every MPA site. Visual or creel/vessel based surveys are fairly accurate in terms of estimating return on fishing effort invested.

Changes in the type of fishing gears being used and the number of boats and fishers may be both more easily measured and more useful in terms of identifying fishing pressure issues and increases. Likewise, changes in the size and composition of catch is and or more important as how many fish are being caught.

CPUE is not necessarily a good indicator for ecological change and therefore are not alone sufficient to identify and prevent imminent collapses for all fishery stocks. Also, the long-term, consistent monitoring perspective required for CPUE data makes it very difficult to correlate CPUE with environmental change.

The evaluation team should check for accuracy in fishing effort and CPUE reporting submitted from volunteer fishers and, if possible, ensure the falsification or misreporting of data. Data accuracy related to submitted catch reports from all fishers should not be assumed.

[@@@ Insert a strength/weaknesses table with support from pilot site test results/feedback]

Example

[@@@ Example data to be inserted later from pilot site data collected]

Useful References:

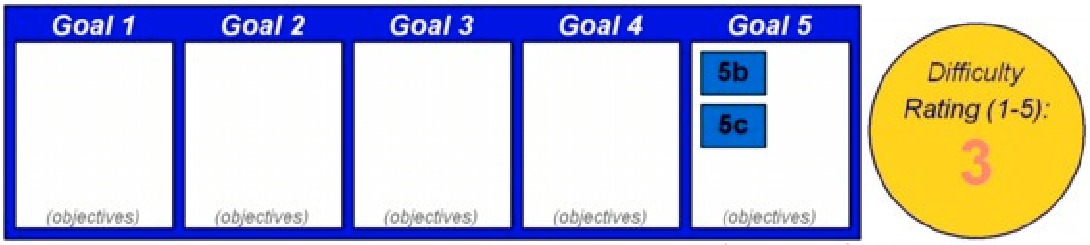
Locally Managed Marine Areas Network (2002). Learning Framework of the Locally Managed Marine Areas Network. Unpublished report. Available online at: www.LMMAnetwork.org.

[@@@ All citations need finishing]

CPUE vessel methods
Creel survey techniques
IMA methods of destructive fishing survey and measurement
Simple CPUE methods from ICLARM 1980s study in San Miguel Bay and Costa Rica.
Polunin, N. and C. Roberts 1995 Reef Fisheries
Russ, Gary and Peter F. Sale 1991. Ecology of Coral Reef Fishes.
Jennings, Simon et al Marine Fisheries Ecology
Dulvy, Nick Conservation Biology

[Insert URLs for these resources]

Biophysical Indicator 9: Area Restored



What is 'Area Restored'?

The total proportion of area (km^2 and/or % of total target area/biomass) of the whole that has been returned or "restored" to either: (1) an original target level of community composition and diversity and ecological functioning that is representative of "natural conditions" (non-human induced) or a relatively undisturbed environment, such as 90% of the standing spawning stock occurring naturally; or (2) an identified target level of sustainable population levels and ecological integrity below natural conditions, such as 20% of the standing spawning stock present occurring naturally. Whether the restoration target is back to full "natural conditions" or some identified level below this is dependent on the goals and objectives of the MPA; e.g., a MPA goal to "restore back to sustainable levels where the population can replenish itself" versus a MPA goal to "restore back to naturally occurring levels."

It should be noted that in some MPA locations that frequently experience natural disturbances (e.g., cyclones) which limits/prevents the restorative capacity of the project, this indicator may not easily be applicable. In such cases, the "natural conditions" restoration target may not be realistic and instead may need to give way to a compromise restoration level that is sub-natural conditions.

Finally, this indicator may not be relevant at all MPA sites, depending on the extent (or even presence) of restoration targets within the MPA goals and objectives.

Why Should this Indicator be Measured?

This indicator is a discrete measure of amount of area (with constituent biotic and abiotic attributes) that has been returned to target operational conditions, from fully restored to natural conditions through some defined level under this. As such, it attempts to act as a concrete success measurement of MPA performance against the stated restoration target. It is a universally understood indicator of interest to stakeholders, decision-makers, donors, and researchers.

Note that this indicator should not be measured by MPAs where the goals and objectives of the area do not include "restoration" (either back to natural state or sustainable fishing levels). However, if "restoration" is a clearly defined management objective at a MPA, this indicator is a direct measurement of the extent to which this aim is being achieved.

What Is Required to Measure the Indicator?

An accurate basemap of the project area, MPA delineation, and habitat types is needed. A hand-held GPS unit is needed to delineate areas. In addition, the requirements listed under *Community Composition* and *Habitat Complexity and Integrity* also apply here.

Ideally, the evaluation team should have a desired target of the degree of area that is to be “restored” within the MPA. This target may be derived easily from the MPA goals and objectives, but in other cases the MPA management team may need to think carefully about setting measurable aerial restoration targets annually and incrementally through time. From such targets this indicator can be more easily measured.

How Are Data Collected on the Indicator?

To document the recovery of fish or mobile invertebrate focal populations, use a visual census to estimate and document the threshold level of population recovery (as a % change in population size and structure). Such recovery thresholds may likely have little grounding in scientific literature or fisheries biology, but for the purposes of the indicator they must serve as a “best guess” that can be adjusted and refined. For areas (km^2) that are closed and fully-protected to allow recovery of focal fish and invertebrate populations, their recovery in the closed area can sensibly expressed as the proportion of the overall population in which the local sub-populations have exceeded the assumed (designated) recovery thresholds.

On the other hand, within an area not fully closed but under restoration, it is the proportion of that area, or the proportion of sample stations in the area, that have exceeded a ‘recovery milestone’. The ‘recovery milestone’ is defined as the exceeding of a known reference point for *focal species abundance*, *community* (esp. habitat) *composition and structure*, and *habitat complexity and integrity*. These indicators could be derived based on a frequency analysis of areas exceeding the recovery milestone or threshold at a large enough number of samples in the designated area (within and outside the MPA). A stratified or randomized sample of observation stations would be made throughout the designated area at which ratings or estimates of these indicators would be captured through time. Therefore, the extent of area restored could be expressed not only in terms of area (km^2), but also as the proportion (%) of stations at which the observed index exceeds a pre-defined level (e.g., recovery milestone).

Samples for this indicator could be undertaken between every two to five years throughout observation stations across the project area. In order to sample an adequate number of stations within larger MPAs, this may take an increased time investment.

How Are Results Interpreted and Shared?

Disseminate results of the proportion or ‘recovery milestone’ frequency within the total project area and quantify the total area restored (km^2). Keep in mind that such discrete measurements (number of recoveries, total area) are effective and popular communication tools with stakeholder, public, decision-maker, and donor audiences.

Outputs:

- Total project area (km^2) restored fully (100%) versus partially (as % of change in structure, biomass, density/abundance, or total cover)
- Estimated proportion (% change in population density, structure, or biomass) of recovery within focal species population against specified target
- Estimated frequency with which 'recovery milestones' are met across focal species populations within the community

Strengths and Limitations of this Indicator:

This indicator is easy to collect and can be done with relatively low investment in terms of time and labor. However, setting 'recovery milestones' and sustainable population levels is not easy and often poorly understood or documented. As a result, the reliability of results arising out of this indicator is questionable in terms of population recovery threshold measurement.

[@@@ Insert a strength/weaknesses table with support from pilot site test results/feedback]

Example

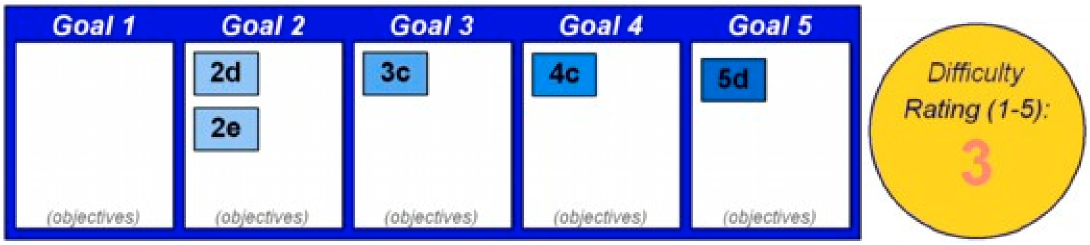
[@@@ Example data to be inserted later from pilot site data collected]

Useful References:

[@@@ All citations need finishing]

[Insert URLs for these resources]

Biophysical Indicator 10: Area Under Reduced Human Use/Impacts



What is 'Area Under Reduced Human Use/Impacts'?

This indicator is a measure of the total area within the MPA of reduced human impact compared to non-managed waters. Theoretically (and ideally in practice), if an MPA is successful in abating threats present then the total area under reduced human impact should at least equal the total MPA area. However, this indicator attempts not only to test this assumption but also qualify it comparably through time.

Human impacts on the marine environment arise from use (both extractive and non-extractive) of the area. Examples of human extractive and non-extractive uses within coastal waters include fishing, tourism, aquaculture, coastal development, transportation, trade, and other forms of commerce. A particular concern of human activity under this indicator is destructive fishing. Also, varying levels of human use can result in varying levels of impact. For example, the type and number of certain fishing gears (e.g., bottom trawls, purse seines, and gill nets) are known to have significantly higher impacts on ecosystems than others (e.g., pole and line and cast nets). Such extractive and non-extractive uses are well documented to often have negative anthropogenic effects (impacts) associated with them. As such, this indicator attempts to both: (a) quantify the total area under reduced impact from restriction or management of human uses, and (b) quantify and qualify whether or not these uses are increasing or decreasing in operation/presence through time.

It should be noted that this indicator is closely linked to several socioeconomic (particularly local use patterns, livelihoods, and occupational structure) and governance (particularly rights and rules) indicators.

Why Should this Indicator be Measured?

An understanding of the patterns of use within the MPA and surrounding waters can assist managers in identifying, minimizing, or eliminating threats and negative use impacts. Human impact reduction is an understood and critical need to be met through the use of an MPA, and measuring the reduction of such impacts through time is therefore important to document in order to legitimize and improve on MPA use.

Whereas many of the other biophysical indicators are focused on measuring management effectiveness vis-à-vis changes in ecological condition, this indicator is concerned with measuring management effectiveness as it relates directly to reductions in threats associated with human use and anthropogenic impacts. In this regard, the indicator attempts to measure what is actually the impact of the use of the MPA on reducing operating threats in comparison to what is stated on paper (the MPA goals and objectives to do the same). This indicator is not a 'true' biophysical indicator in that it does not attempt to assess the state of biological trends or physical processes in the MPA, but rather acts as a contextual indicator in assessing trends that have an impact on the biophysical conditions. In this sense, it may prove useful as a rapid qualitative assessment tool in indicating how the biophysical environment, or specific attributes, within and outside the MPA may be being impacted and experiencing change. However, the indicator should only be measured in conjunction with other 'true' biophysical indicators, and the results of the indicator should not be considered 'valid' on their own. Given the subjective nature of the results generated from this indicator, they should not be used as stand-alone evidence of MPA management effectiveness.

Results from this indicator will be of most relevance and use when linked with other biophysical assessment results, and in describing the history and contextual background of threats operating at the MPA site.

What Is Required to Measure the Indicator?

(1) A firm understanding is needed of the types of human activities and threats that are presently operating within the coastal waters being managed, including the level of intensity, the area, and the urgency with which these activities are being undertaken. Secondary (literature) and primary data sources to triangulate/validate and refine these level of threats is helpful and should be encouraged where possible;
(2) Knowledge is needed of the types of fishing gears and technologies being used within the area, including destructive fishing techniques. An estimate of where these various fishing technologies are being employed is also helpful; and
(3) Stakeholders willing to openly sharing their observations, experiences, and beliefs.

Ideally, the evaluation team should have a desired target of the degree to which human use impacts have been "reduced" within the MPA. This target may be derived easily from the MPA goals and objectives, but in other cases the MPA management team may need to think carefully about setting measurable impact reduction targets annually and incrementally through time. From such targets this indicator can be more easily measured.

How Are Data Collected on the Indicator?

As part of the baseline assessment of human use and impacts (both upland and coastal), identify and document key physical, chemical, and other environmental conditions that are either man-made or occurring naturally. This should be done for both inside and outside the MPA for all extractive and non-extractive uses that are known to have deleterious impacts on the species, habitats, and community ecology within the site waters. The key threats (both human induced and natural) may already be identified and previously prioritized for management action (such as MPA use) aimed at eliminating or minimizing such threats over time. Categorize the threats identified and listed either into extractive or non-extractive use.

There are a number of ways that data on threats present and the impacts of various human activities can be collected within the project area over time. Key informant interviews across stakeholder groups can help to identify initially the scope of known threats and human uses within the area. The impacts of these threats and activities can be assessed through user and other stakeholder group interviews and secondary data sources. Trends and numbers of users within a particular activity (fishing or otherwise) can also be collected through user groups interviews using a historical prospective survey and likert scales.

For each type of threat/human activity, a description of the: (a) intensity, (b) extent of area (spatial distribution), (c) and frequency or urgency (temporal distribution) can be profiled through user group and stakeholder interview and focus group discussion. These threat descriptions can be qualitatively summarized along with a quantitative assessment of the trends (i.e., number of users, frequency of activity) and spatial extent (total area where activities are observed) of threats present, as relevant.

Measure changes in human use trends as evidenced through changes in both the types of extractive gears/technologies used (particularly in regard to the extractive efficiency of such technologies as well as destructive technologies) as well as changes in the power (extractive and non-extractive effort in terms of the number of fishers, number of boats, number of gears, etc.) of extractive and non-extractive effort observed through time. Map the extent of use of such technologies and effort observed within the area managed. Capture numerical measures of gear types, numbers, and power used within a matrix and track through time (annually). Identify and closely monitor shifts toward over-efficient technologies and increased power (effort) patterns.

In terms of collection data on the extent of destructive fishing methods used within the managed area, estimate the total area known where such technologies are used. Additionally, calculate the percent of area (km^2) within the MPA where destructive fishing technologies and other fishing techniques are prohibited. Destructive technologies include the use of poisons (e.g., potassium and sodium cyanide, bleach, customary poisons), dynamite, bottom trawling, physical destruction with tools etc., and fine mesh nets for extraction.

These data should be collected annually to sub-annually, depending on which threats are present and their trends. This will allow for comparison of results within and between years.

Also, it must be noted that the synergistic and dynamic effects of threats on one another is not fully captured under the methods outlined here. As a result, positive and negative feedback loops and impacts resulting from the dynamics of threats operating on one another should be documented qualitatively.

Measurement of this indicator is closely linked to the collection of similar data under other governance and socioeconomic indicators, particularly *Human Use Patterns*.

How Are Results Interpreted and Shared?

Through focus groups, build a descriptive profile and mapped delineation of the threats operating within and outside the MPA at the site. Monitor changes in the quantitative trends of extractive technology and power (effort) through time and the extent of their use spatially within the site and MPA. Track any changes (increase or decrease) observed in the area where destructive fishing technologies are being used. Disseminate summary results of threats profiled and changes observed relating to threats with various stakeholders, managers, and decision makers. Encourage group analysis of these threats through discussion and mapping of the threats and how they conceptually relate (causal relationships) to one another. A simple method for group identification and conceptual modeling of threats present is summarized in Margoluis and Salafsky 1997.

In addition to this descriptive analysis, use results generated to complete a threat reduction index (TRA) with project team and stakeholder representatives. The logic behind TRA is that if a project team can identify the threats to the coastal ecosystems, then the team can assess the progress through time in achieving conservation by measuring the degree to which these threats are reduced. The TRA index is designed to identify threats, rank them according to their relative importance and produce a weighted score, assess project progress in meeting each of them, and then pool the information to obtain an estimation of actual threat reduction as a percentage of total potential threat reduction. The TRA is undertaken so that meaningful comparisons can be made across different projects as to the degree to which human use impacts have been mitigated over the project period. Detailed guidance for using the Threat Reduction Assessment can be found in Margoluis and Salafsky (2001). A theoretical discussion of the TRA methodology can also be found in Salafsky and Margoluis (1999). Examples of how the TRA has been used by conservation practitioners can be found in Salafsky et al (1999). The TRA should be done at the outset of the MPA and every two years thereafter.

Outputs:

- Threat reduction index (score of 1-100%)
- Threat assessment profile and prioritization
- Map of threat activity within and outside the MPA; areas of destructive fishing technology use
- Percents and total area of threat presence within MPA and overall site

Strengths and Limitations of this Indicator:

Human use/threat and impact data are relatively easy and inexpensive to collect. However, collection of these data requires the interviewing of an adequate number of users and stakeholders in addition to supplemental focus group discussion and activity. All of this may take more time than would be originally assumed under this indicator. Also, data collected under the indicator are largely subjective and therefore not subject to statistical inference or confidence unless using non-parametric analysis of ranking data. Results should be thought of as guideposts and proxies, not evidence.

Further, while the indicator is conceptually useful, it is not easily collected. The threat qualitative nature of the reduction assessment methods stated may be quite difficult to measure with many stakeholders, even subjectively.

Finally, as this is not a 'true', empirically-driven biophysical indicator, the indicator should only be measured in conjunction with several other biophysical indicators, and the results of the indicator should not be considered valid on their own. Results may be of most relevance and use when linked with other biological assessment results and in describing the history and contextual background of threats operating at MPA sites.

[@@@ Insert a strength/weaknesses table with support from pilot site test results/feedback]

Example

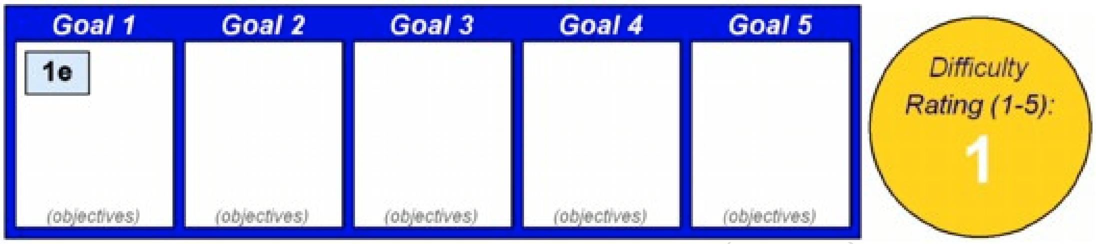
[@@@ Example data to be inserted later from pilot site data collected]

Useful References:

Margoluis, R. and N. Salafsky (2001) Is Our Project Succeeding? Using the Threat Reduction Assessment Approach to Determine Conservation Impact. Biodiversity Support Program, Washington, DC.
Margoluis, R. and N. Salafsky (1998) Measures of Success: Designing, Managing, and Monitoring Conservation and Development Projects. Island Press, Washington DC.
Salafsky, N., B. Cordes, J. Parks, and C. Hochman (1999) Evaluating Linkages Between Business, the Environment, and Local Communities: Final Analytical Results from the Biodiversity Conservation Network. Biodiversity Support Program, Washington DC.
Salafsky, N. and R. Margoluis (1999) Threat reduction assessment: A practical and cost-effective approach to evaluating conservation and development projects. Conservation Biology 13: 830-841.

[@@@ Citation needs finishing];[Insert URLs for these resources]

Biophysical Indicator 11: Area Free from Extraction



What is 'Area Free from Extraction'?

The area free from extraction is a calculation of the total area that has been set aside as reserved, or fully-protected, from all human harvest activity within the MPA. Often such areas are delineated as separate "no-take core areas", "sanctuaries", or "marine reserves" within the overall MPA. Many times the prohibition in this area extends to include the forbidding of all human activity, whether extractive or non-extractive, within the area. One frequent exception to this extended prohibition is for research and monitoring activities.

This indicator does not presuppose that by having a no-take area designated in the MPA, it means that this area is actually free from extraction. The intent is to determine the presence and amount of a no-take area, not the extent to which it is *effectively* free from extraction.

It is noted that not all well-designed and effectively managed MPAs have no-take areas. In this case, the indicator is still measured and scored zero (no area free from extraction; see below).

Why Should this Indicator be Measured?

This indicator essentially tries to identify if no-take areas have been established within the MPA, and if so, to what extent. The indicator is relevant given the large international emphasis upon promoting the use of reserves or no-take areas within the MPA paradigm and agenda. In particular, there is increasing attention being given to identifying and comparing the benefits that arise from the use of no-take areas to those arising from use of partially-restricted and multiple-use managed areas under the broad definition of MPAs. An emerging conventional wisdom is that no-take areas may provide more biological benefits to a managed area of water than that of partially-restricted and/or multiple use areas. In order to test this assumption, this indicator must be collected.

What Is Required to Measure the Indicator?

An understanding is required of the delineated boundaries of the overall MPA and any fully-protected or reserve areas that occur within or overlapping the overall MPA. This may entail the use of a global positioning system (GPS) unit to delineate these boundaries. A map delineating these areas is also required in order to calculate the total area of both reserve (fully-protected) and non-reserve waters under management.

How Are Data Collected on the Indicator?

Measurement of this indicator is focused on those MPAs that have been designed with or as a no-take area and that have corresponding as well as the goals and objectives of the MPA. For MPA sites that do not have area free from extraction, the score is zero.

For those MPA with no-take areas, first calculate the total area (in km^2) included within the MPA. Next, calculate the total area (in km^2) of all locations within the MPA that are free from all human extraction. Note that such areas may already be delineated separately within the overall MPA as “no-take core areas”, “sanctuaries”, or “marine reserves”. Also note that such areas may allow non-extractive uses (such as transportation, diving, and other water recreation) of the area. Finally, subtract the total area free from extraction from the total MPA area to determine the total area within the MPA that is not free from all human extraction.

Calculations should be checked/updated every year, unless needed sooner (i.e., changes to the existing boundaries are made during the year).

This indicator is closely related to the enforcement and surveillance-related governance indicators, and data collection should be timed accordingly. Because of the link of this indicator to several governance indicators, answering the following questions related to the no-take area may be of interest or use to the evaluation team during its investigation: (1) How was the specific delineation of the no-take area defined? Was it demarcated based on biological parameters or political convenience? (2) How effective is fisher compliance with the no-take area? Are there any reported/confirmed (or unreported/unconfirmed) violations of extractive activities taking place in the area? (3) What form of surveillance and enforcement are being conducted in the area? How certain are those who police/enforce the area that the area truly is being observed as “no-take” zone? The responses to such questions will assist the evaluation team in determining whether or not the designated area free from extraction is being effectively managed or not, and the degree to which violations (if any) are occurring in the area. Note however that answering such questions is not the purpose of this indicator.

How Are Results Interpreted and Shared?

Correlate the results of other biophysical indicators with and without the use of reserves. Are results within areas free from all extraction significantly different from results in other multiple use and partially-protected areas of the MPA? For example, are changes observed in the same focal species abundance and within relatively adjacent areas significantly different between reserve and non-reserve waters within the MPA? Through time, is a greater or reduced percent of total MPA area found under full protection? Finally, is there an optimum percentage (20%? 50%) of reserve versus non-reserve waters found within multiple-zone MPAs that are being achieved through time? If so, on what grounds (why)?

As data collection for this indicator will be undertaken in tandem with data collection for related surveillance and enforcement governance indicators (e.g., number of violations), interpretation of how effectively the no-take area is actually being policed by enforcers and complied with by fishers may also be of interest to target audiences.

Outputs:

- Total area (km^2) of the MPA.
- Total area (km^2) free from extraction (reserved waters); minimum area = 0; maximum area = total MPA area.
- Map of the boundaries of the MPA at the site and the reserve (free from all human extraction) area(s) within or overlapping it.
- GPS coordinates for these areas (if applicable).

Strengths and Limitations of this Indicator:

The data needed for this indicator are easily, inexpensively, and rapidly collected.

There are no limitations in collecting this information with the exception that for larger MPAs, the collection of GPS coordinates and calculation of total areas may take more time.

Relevance of this indicator will vary widely depending on MPA design and no-take use as well as the goals and objectives of the MPA.

[@@@ Insert a strength/weaknesses table with support from pilot site test results/feedback]

Example

[@@@ Example data to be inserted later from pilot site data collected]

Useful References:

[@@@ All citations need finishing]

C. Roberts and J. Hawkings (2000) A Manual for Fully-Protected Areas. WWF
NCEAS Statement (2000)

[Insert URLs for these resources]

A1-3 The 17 Socioeconomic Indicators

Figure 7. The 6 goals and 18 objectives related to the socioeconomic indicators.

MPA Goal 1: To maintain and/or enhance food security for local communities

- **1a** Objective: Improve local nutrition.
- **1b** Objective: Improve the availability of locally caught seafood for dietary/food use.

MPA Goal 2: To maintain and/or enhance livelihood opportunities for coastal residents and marine resource users

- **2a** Objective: Improve the economic status and relative wealth of coastal communities .
- **2b** Objective: Stabilize or diversify the community and household occupational/income structure by reducing resource dependency for future generations.
- **2c** Objective: Improve coastal resident access to markets and capital.
- **2d** Objective: Improve or contribute toward the health of local communities.

MPA Goal 3: To enhance the non-monetary benefits of the area to society

- **3a** Objective: Maintain or enhance aesthetic values.
- **3b** Objective: Maintain or enhance existence values.
- **3c** Objective: Maintain or enhance wilderness value.
- **3d** Objective: Maintain or enhance recreation opportunities.

MPA Goal 4: To strive towards the equitable distribution of benefits from coastal and marine resources and the cost of protection

- **4a** Objective: Equitable monetary benefit distribution to and through local communities.
- **4b** Objective: Equitable non-monetary benefit distribution to and through local communities.
- **4c** Objective: Improved equity among social groups (e.g. among minorities, between genders).

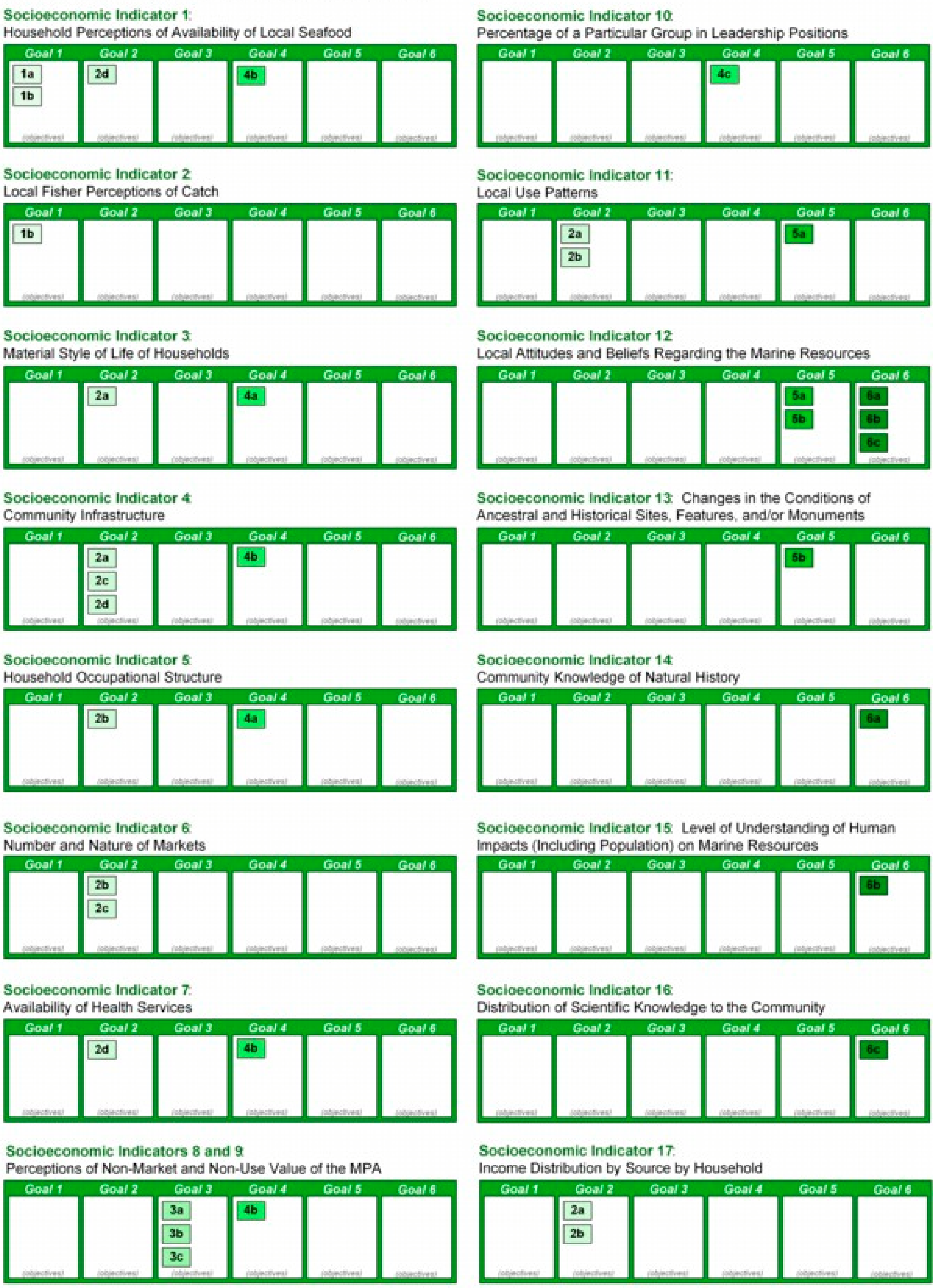
MPA Goal 5: To maximize compatibility between the management and local culture

- **5a** Objective: To minimize adverse effects on traditional relationships/systems that support the MPA .
- **5b** Objective: Maintain or enhance ancestral & historical features, sites, or monuments linked to resources.

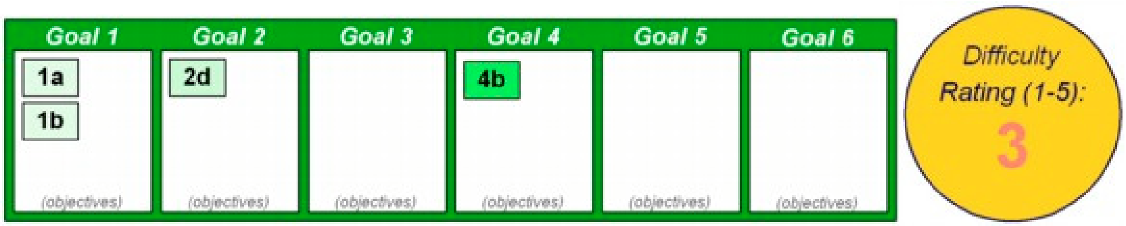
MPA Goal 6: To enhance environmental awareness and knowledge

- **6a** Objective: Enhance respect and/or understanding of traditional knowledge that supports the MPA.
- **6b** Objective: Increase understanding of "sustainability".
- **6c** Objective: Enhance scientific knowledge.

Figure 10. The 17 socioeconomic indicators presented in this guidebook, and their relationship to the 6 socioeconomic goals and 18 associated objectives.



Socioeconomic Indicator 1: Household perceptions of availability of seafood



What is 'household perceptions of availability of seafood'?

Household perception of the availability of seafood is a measure of how the primary food purchaser/preparer in the household thinks about the local availability of seafood for the household.

Why should this indicator be measured?

This indicator is important to understanding the contribution of the MPA to food security in the local community. Household food security can be defined as "that state of affairs where all people at all times have physical and economic access to adequate, safe and nutritious food for all household members, without undue risk of losing such access" (FAO).

This indicator is especially important if one of the stated objectives of the MPA is to improve local nutrition food or the availability of local seafood. For example, households may respond that the availability of seafood has been reduced right after the establishment of the MPA, but two years later they may respond that seafood availability has increased. If household perceptions of availability of local seafood does not improve or if it drops in the MPA community, and if similar trends do not appear in the control communities, one could suspect that the MPA is negatively impacting seafood availability. If this is so, and if this is not a desired impact, the MPA management plan and management measures must be adjusted.

This indicator will also be useful in responding to complaints from the local community about the MPA. If households perceive an increase in the availability of local seafood over time, than this information can be used in support of the MPA.

What is required to measure the indicator?

a. Survey of food purchaser/preparer in the households in the MPA community
b. List of households to be surveyed
c. Interviewers
d. Ladder-scale diagram (optional)
e. Paper/pencil

How are data collected on the indicator?

Several questions are asked of households in the MPA community to measure perceptions of availability of local seafood. In particular, the household primary food purchaser/preparer is interviewed. The questions can be asked in a separate survey or as part of a larger survey that includes questions from other indicators. The questions might include:

a. How many days during the past month did your family have an insufficient amount of food?
Never____, Once a week_____ , Twice a week_____, More than twice a week______
Specify number of days: _______
(This question should be asked for the same period (season, month) every year since there are seasonal differences in food and seafood availability)

b. How many days during the past month did your family have an insufficient amount of local fresh seafood due to lack of availability?
Never____, Once a week_____ , Twice a week_____, More than twice a week______
Specify number of days: _______
(This question should be asked for the same period (season, month) every year since there are seasonal differences in seafood availability)

c. How many days during the past year did your household have an insufficient amount of local fresh seafood due to lack of availability? Never____, Specify number of days________, Specify month(s) or season_______________

d. Have you observed changes in the availability of local seafood since the MPA was established? Increase___ Same____ Decrease_____

e. Why?

f. Do you feel that the MPA is having an impact on the availability of local fresh seafood? Yes/No

g. Why?

An alternative to these questions if to use a self-anchoring scale. This approach utilizes a ten point ladder-scale where the bottom step indicates no seafood at all and the top step indicates the availability of more than enough seafood for the family throughout the year. The respondent is asked to identify on the ladder-scale the situation at the present time and the situation at some time period in the past (such as before the MPA). The number of and direction of change in the steps is a measure of the perceived change.

How are results interpreted and shared?

The data are presented in a table showing percent distribution of the responses to each question. The strength of this indicator is having data to compare over time so that trends in responses can be measured.

Outputs

- Tables on the availability of food and seafood in the local community.

Strengths and Limitations of this indicator

The usefulness of this indicator will depend upon the availability and cooperation of the household food purchaser to respond to the questions. Also, it is assumed that when using this indicator to evaluate food security, specifically improvements in local nutrition, that availability and consumption of local fresh seafood contribute positively to nutrition.

Analysis of the data from the self-anchoring method involves calculating mean values for the differences between each indicator for today (T2) and the pre-project period (T1). A paired comparison t-test is conducted to determine whether the mean differences between the two time periods are statistically significant.

	Strength	Weakness
Measurable	+	
Consistent	+	
Precise	+	
Sensitive	+	
Simple		-

Example:

[to be inserted]

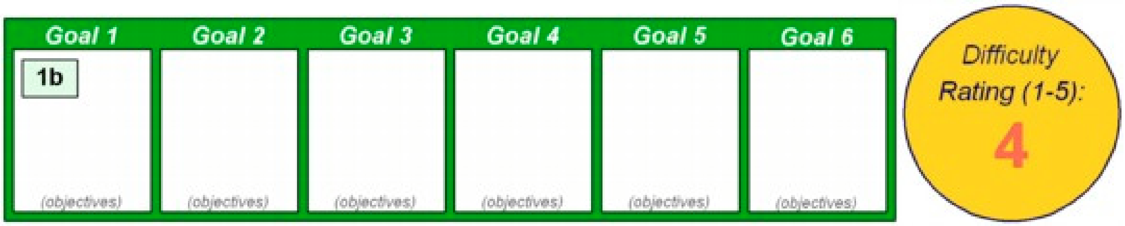
Useful References and Other Information:

Leah Bunce, Philip Townsley, Robert Pomeroy and Richard Pollnac. 2000. Socioeconomic manual for coral reef management. Australian Institute of Marine Science, Townsville, Queensland, Australia. Available on www.reefbase.org

Fikret Berkes, Robin Mahon, Patrick McConney, Richard Pollnac and Robert Pomeroy. 2001. Managing small-scale fisheries: alternative directions and methods. International Development Research Centre, Ottawa, Canada. Available on www.idrc.ca/booktique

Richard Pollnac and Brian Crawford. 2000. Assessing behavioral aspects of coastal resource use. Coastal Resources Center Coastal Management Report # 2226. Coastal Resources Center, University of Rhode Island, Narragansett, Rhode Island. Available at www.crc.uri.edu

Socioeconomic Indicator 2: Local fisher perceptions of harvest



What is 'local fisher perceptions of harvest'?

Local fisher perceptions of harvest is a measure of how local fishers think about the availability of target fish species and changes in the availability of fish.

Why should this indicator be measured?

This indicator provides information on fisher's perception of changes in the availability of target species, which is useful for determining if the MPA management is achieving its objective of increasing harvest of seafood and consequently the availability of locally caught seafood. If the perceptions are a positive increase, then the fishers may be more receptive to MPA management. If the perceptions are negative, then the fishers may be less receptive to MPA management, and changes in MPA management may be necessary. The indicator is also a useful measure of fish abundance, availability and size and species composition.

What is required to measure the indicator?

- Survey form
- List of fishers to be surveyed
- Interviewers
- Ladder-scale diagram
- Paper/pencil

How are data collected on the indicator?

Information on this indicator is collected by conducting a survey of fishers. They may be asked:

Compared to ten years ago, what is the quantity of available (target species)?"
A lot less____ less_____ same_____ more_____ A lot more______

The responses produce a five point scale ranging from a lot less to a lot more with same in the middle.

As an alternative, a self-anchoring scale can be used. This approach utilizes a ten-point, ladder-scale where one is the worst situation and 10 is the best situation. The respondent is asked to identify on the ladder-scale the situation at the present time and the situation at some time period in the past (such as before the MPA or a period of years ago). The number of and direction of change in the steps is a measure of the perceived change. For this approach the fisher is provided the following scenario and question:

A one indicates a situation where none of the target species are available and a ten indicates a situation where there are so many fish that the fisher can catch as many as he/she wants in a very short period of time. Given this scale, how would you rank conditions: Today_______ Before the MPA_________

How are results interpreted and shared?

The data from the first question of comparison are presented in a table showing percent distribution of the responses to each category (i.e. a lot less, less). The strength of this indicator is having data to compare over time so that trends in responses can be measured.

Analysis of the data from the self-anchoring method involves calculating mean values for the differences between each indicator for today (T2) and the pre-project period (T1). A paired comparison t-test is conducted to determine whether the mean differences between the two time periods are statistically significant.

Indicator	T1	T2	T2-T1	*P*
Availability of target species	4	6	2	<0.01

Outputs

- Table of graded ordinal judgment of local fisher perception of fish harvest.

Strengths and Limitations of this indicator

A limitation of this indicator is that fishers who have fished on target species in impacted (target) area over the time period being evaluated must be present and willing to respond to the questions. Also, every individual's baseline for assessing status and changes in fish catch is personal and not really intergenerational. As a result, historical overfishing is often not evaluated in this assessment of people's perceptions of the status of the fishery.

	Strength	Weakness
Measurable	+	
Consistent	+	
Precise	+	
Sensitive	+	
Simple		-

Example:

[to be inserted]

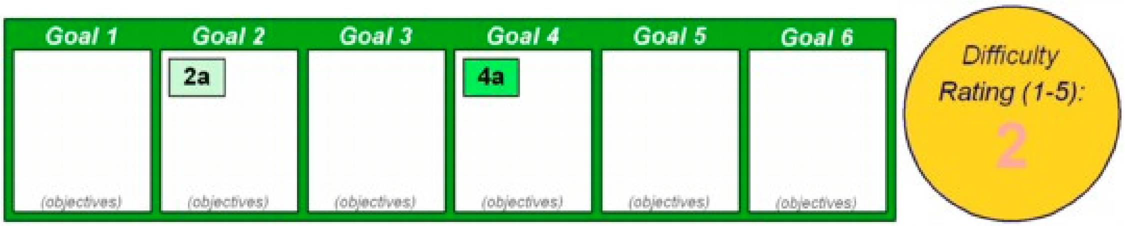
Useful References and Other Information:

Leah Bunce, Philip Townsley, Robert Pomeroy and Richard Pollnac. 2000. Socioeconomic manual for coral reef management. Australian Institute of Marine Science, Townsville, Queensland, Australia. Available on www.reefbase.org

Fikret Berkes, Robin Mahon, Patrick McConney, Richard Pollnac and Robert Pomeroy. 2001. Managing small-scale fisheries: alternative directions and methods. International Development Research Centre, Ottawa, Canada. Available on www.idrc.ca/booktique

Richard Pollnac and Brian Crawford. 2000. Assessing behavioral aspects of coastal resource use. Coastal Resources Center Coastal Management Report # 2226. Coastal Resources Center, University of Rhode Island, Narragansett, Rhode Island. Available at www.crc.uri.edu

Socioeconomic Indicator 3: Material style of life of households



What is 'material style of life of households'?

Material style of life of households is an indicator of the relative social status of a community and is often used as an indicator of wealth. It involves assessing households structures (e.g. roof, walls) and furnishings (e.g. television, radio).

Why should this indicator be measured?

Material style of life is important to determine the extent of equity of monetary benefits through the community. It is also important for understanding the economic status and relative wealth of coastal communities. It is particularly useful to determine changes in wealth where it is difficult or impossible to obtain accurate income data.

Positive economic impact of the MPA should be indicated by increasing material style of life items present in the community households. If the MPA has a positive impact on improving economic or social status or relative wealth, it should be indicated by increasing material style of life scores over time in the MPA community. Increase should be larger in MPA communities than in control communities. Likewise, if MPAs have an equitable impact, increases in material style of life scores should occur for all identified social groups, especially poorer and disadvantaged groups in the community . If this has not occurred, then the MPA project manager should compare findings with the control community. If changes are less negative in the MPA community, the MPA is probably not responsible for the negative change.

What is required to measure the indicator?

- Survey form
- Interviewers
- List of households to be surveyed
- Paper/pencil

How are data collected on the indicator?

As a first step, the appropriate assets to assess need to be determined based on locally derived items associated with wealth and poverty. This list should include items that are likely to be purchased or upgraded within a reasonable time period, such as five years. The list will usually include items about type of roof, structural walls, windows, and floors.

These lists are not simple to construct. For example, house structure indicators might include four roof types: thatch, wood, tin and tile. One could select only the most expensive type and use it in the list, but that would leave out all the gradation available in the different types. If the different types are used, how does one assign value to each type? The addition of different wall, floor, and window types, as well as appliance and other furnishings, greatly complicates the problem. The measure cannot be a simple addition of items. Items must be evaluated, accepted or rejected, and given weights based on their actual distribution. There is a long history of scale construction which deals with these problems, and techniques such as Guttmann scale analysis and factor analysis have been developed. Accurate scale construction is needed to make meaningful comparisons between individuals and groups of individuals (occupational subgroups, communities), as well as to make comparisons between different time periods, such as pre- and post-MPA.

Most importantly, the lists of assets to be measured should be appropriate to conditions of wealth within the target areas, to facilitate comparisons and measure change. For example, in one area a television may be considered by the local people as the top household asset representative of wealth, while in another area a radio is considered to be the top asset of household wealth.

The list of household structures and furnishings might include:

type of roof: tile ____ tin____ wood___ thatch _____
type of outside structural walls: tiled ____ brick/concrete ____ wood___ thatch/bamboo ____
windows: glass___ wooden ____ open______ none ____
floors: tile____ wooden ____ cement ____ thatch/bamboo____ dirt_____
toilet: flush____ pail flush_____ outdoor_______
water: inside tap____ pump_____ outside tap_______
electricity: yes___ no___
household furnishings: fan____ refrigerator____ radio___ television____ wall clock____

The actual collection of material style of life data during the survey is not difficult. A list is prepared and the interviewer simply checks off the items by asking the respondent if they are present or not, or by observation.

How are results interpreted and shared?

The items are totaled and percent distribution for each item is reported in a table showing the percent distribution of material items.

Table: Percent distribution of material items in Village A

Item	Village A
Bamboo wall	30
Cement wall	57
Wooden wall	15
Glass window	55
Wooden window	45

Outputs

- Table of percent distribution of material items for community

Strengths and Limitations of this indicator

One of the major difficulties with this indicator is properly identifying household items indicative of relative wealth/poverty in the community. In addition, it is often difficult to separate impacts of the MPA from impacts of other economic changes in the household caused by general economic and community development.

	Strength	Weakness
Measurable	+	
Consistent	+	
Precise	+	
Sensitive	+	
Simple	+	

Example:

[to be inserted]

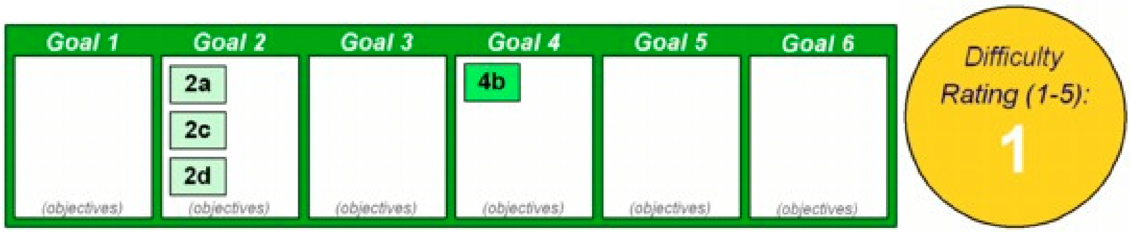
Useful References and Other Information:

Fikret Berkes, Robin Mahon, Patrick McConney, Richard Pollnac and Robert Pomeroy. 2001. Managing small-scale fisheries: alternative directions and methods. International Development Research Centre, Ottawa, Canada. Available on www.idrc.ca/booktique

Richard Pollnac and Brian Crawford. 2000. Assessing behavioral aspects of coastal resource use. Coastal Resources Center Coastal Management Report # 2226. Coastal Resources Center, University of Rhode Island, Narragansett, Rhode Island. Available at www.crc.uri.edu

R. Pomeroy, R. Pollnac, B. Katon and C. Predo. 1997. Evaluating factors contributing to the success of community-based coastal resource management: the Central Visayas Regional Project 1, Philippines. Ocean and Coastal Management. 36(1-3):97-120.

Socioeconomic Indicator 4: Community infrastructure



What is 'community infrastructure'?

Community infrastructure is a general measure of local community development. It is a description of the level of community services (e.g. hospital, school) and infrastructure (e.g. roads, utilities), which can include information essential to determining sources of anthropogenic impacts on coastal resources (e.g. sewage treatment).

Why should this indicator be measured?

If measured over time, community infrastructure is useful to determining changes in economic status and relative wealth and development of the community, as well as access to markets and capital. A positive change in community infrastructure and services (e.g. improved roads, hospital), indicates an increase in the relative wealth of the community, resulting, in part or wholly, from economic gains obtained from the MPA. A negative change in community infrastructure and services may indicate no or limited changes in the relative wealth of the community being obtained, in part, from the MPA.

What is required to measure the indicator?

- Baseline information on community infrastructure and services
- Survey form and checklist
- Interviewers
- Paper/pencil

How are data collected on the indicator?

This information is collected by interviewing key informants (e.g. mayor, town engineer), reviewing secondary data and/or observing the community. A checklist needs to be developed to enumerate and determine the existence of community infrastructure items. The checklist of items might include:

1.	hospitals	yes___	no___	#____
2.	medical clinics	yes___	no___	#____
3.	resident doctors	yes___	no___	#____
4.	resident dentists	yes___	no___	#____
5.	secondary schools	yes___	no___	#____
6.	primary schools	yes___	no___	#____

7. water piped to homes yes___ no___
8. sewer pipes and canals yes___ no___
9. sewage treatment facilities yes___ no___
10. septic/settling tanks yes___ no___
11. electric service hook-ups yes___ no___ #____
12. telephones yes___ no___ #____
13. food markets yes___ no___ #____
14. hotels and inns yes___ no___ #____
15. restaurants yes___ no___ #____
16. gas stations yes___ no___ #____
17. banks yes___ no___ #____
18. public transportation yes___ no___
19. paved roads yes___ no___

This checklist may also include information on condition of the item (e.g., roads: smooth, few pot holes, or many potholes).

How are results interpreted and shared?

The data is collated and presented in a narrative format. For example:

> Matalom has 1 km of asphalt road (3 km of stone and 0.5 km of dirt), as well as one bridge, which reportedly needs maintenance. The pipe meant to deliver fresh water to the village is broken, so residents must travel by boat to the river for fresh water, which is transported back to the village in plastic jerry cans.

It can also be presented quantitatively by making a table showing the presence and/or number of each item.

Outputs

- narrative presentation of community infrastructure
- table showing presence and/or number of each item

Strengths and Limitations of this indicator

A challenge with this indicator is accurately identifying significant infrastructure items in the community. Similar to material style of life, it is often difficult to separate impacts of the MPA on level of community infrastructure development, such as a paved road or sewage treatment, from impacts of other economic changes in the community caused by general economic and community development.

	Strength	Weakness
Measurable	+	
Consistent	+	
Precise	+	
Sensitive	+	
Simple	+	

Example:

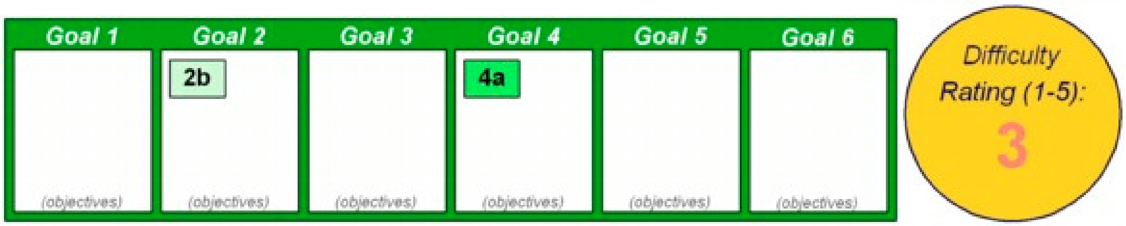
[to be inserted]

Useful References and Other Information:

Fikret Berkes, Robin Mahon, Patrick McConney, Richard Pollnac and Robert Pomeroy. 2001. Managing small-scale fisheries: alternative directions and methods. International Development Research Centre, Ottawa, Canada. Available on www.idrc.ca/booktique

Richard Pollnac and Brian Crawford. 2000. Assessing behavioral aspects of coastal resource use. Coastal Resources Center Coastal Management Report # 2226. Coastal Resources Center, University of Rhode Island, Narragansett, Rhode Island. Available at www.crc.uri.edu

Socioeconomic Indicator 5: Household occupational structure



What is 'household occupational structure'?

Household occupational structure measures the distribution of productive activities (occupation; sources of income, both monetary and non-monetary) across households and social groups (age/gender) in the community. It is a list of all the household members, and each member's occupation. It can also include their gender, age, ethnicity and religion for each household member.

Why should this indicator be measured?

Household occupational structure is an important aspect of social structure as well as an indicator of the relative importance of different uses of the coastal resources. It is an indicator of stabilization or diversification of occupations and level of resource dependency. The indicator is used to determine the percent of households dependent on coastal resources for livelihood, changes in household occupations as a result of the MPA, and to identify and determine the acceptance and relative importance of alternative (non-target resource based) livelihood activities.

This indicator is useful for determining if the MPA and associated activities, such as alternative livelihood activities, are impacting upon households in the community. It is possible to determine, for example, that fishers in the community are shifting from fishing as a primary occupation to fly fishing guides or dive boat operations as a result of the MPA. It will allow for a measure of the dependence of households on coastal resources for livelihood and income and changes over time on that dependence. The indicator results in a measure of impact of the MPA on household occupational structure in the community.

Ideally, one should obtain the value of all coastal activities that contribute to the household, for example, the income earned from fishing, the value of fish brought home for food. The problem is that most primary producers in developing countries do not keep records of income, and income from fishing, for example, varies so much from day to day that it is difficult to provide an accurate figure for weekly or monthly income. It not only varies from day to day, but also from season to season. The difficulty with estimating income is further compounded by the occupational multiplicity. Household occupational structure is a realistic alternative means of understanding the relative importance of these activities to the individual household.

What is required to measure the indicator?

- List of households to survey
- Secondary data on household occupational structure
- Survey form
- Interviewer
- Paper/pencil

How are data collected on the indicator?

Secondary data is an inadequate source of information concerning occupations, since most published statistics only include the full-time or primary occupation. Most coastal communities, especially in rural areas, are characterized by occupational multiplicity – a given individual or household may practice two, three four or more income or subsistence-producing activities. The only way to determine the distribution and relative importance of these activities is with the use of a sample survey.

A survey form is administered to a sample of households in the community. Respondents are asked to list all the members in the household. They then are asked the age and gender of each person and then their primary, secondary and tertiary occupations. A table such as the following can help organize these data.

Household member	Age	Gender	Education	Primary Occupation	Secondary Occupation	Tertiary Occupation
1						
2						
3						
4						

In addition, the respondent is asked about the overall primary and secondary sources of income. This is particularly important to determine the range of household sources of income that may not be noted by occupation such as remittance. The questions might include:

- What is the primary source of household income?
- What is the secondary source of household income?

How are results interpreted and shared?

Distribution of occupations in the community is calculated. As shown in the following sample table, the number of household members throughout the community that were noted as farming for their primary occupation is calculated, then the same for fishing, fish trading and so on. The same calculations are then done for secondary occupations and then tertiary occupations. Once the raw numbers are noted, the percents can be calculated as noted in parentheses in the sample table.

Table. Number of household members in each occupation (percent distribution).

Occupation	Primary	Secondary	Tertiary
Farming	0 (0%)	10 (17%)	0

Fishing	70 (63%)	17 (28%)	15 (17%)
Fish trading	25 (23%)	7 (12%)	10 (11%)
Carpenter	15 (14%)	6 (10%)	0
None	0	20 (33%)	65 (72%)
Total	**110 (100%)**	**60 (100%)**	**90 (100%)**

A similar table is constructed for primary and secondary source household incomes.

A final table can be constructed noting the distribution of age, gender and education.

Outputs

- table of percent distribution of ranking of occupational activities in community
- table of primary and secondary sources of household incomes
- table of distributions of age, gender and education

Strengths and Limitations of this indicator

This indicator can be an accurate measure of dependence on coastal and marine resources if appropriate methods are used. Respondents must know the sources of household income and be able to rank them in terms of relative importance. The interviewers must make it clear to the respondent that the list of activities and ranking must relate to the full year round of activities. This is especially important where there are seasonal differences. Another complication is that defining the household may be challenging in certain locations due, for example, to an extended family living in the house.

	Strength	Weakness
Measurable	+	
Consistent	+	
Precise	+	
Sensitive	+	
Simple	+	

Example:

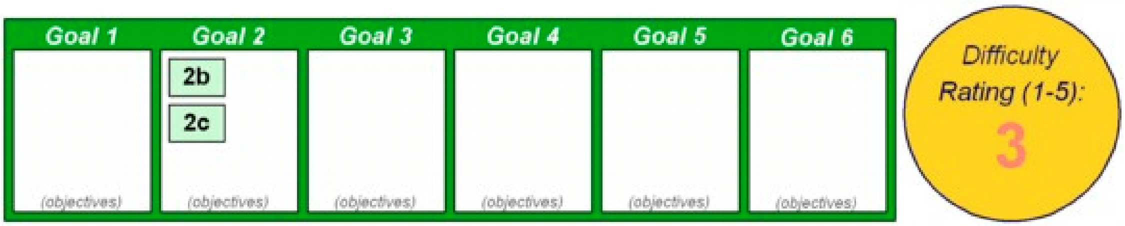
[to be inserted]

Useful References and Other Information:

Fikret Berkes, Robin Mahon, Patrick McConney, Richard Pollnac and Robert Pomeroy. 2001. Managing small-scale fisheries: alternative directions and methods. International Development Research Centre, Ottawa, Canada. Available on www.idrc.ca/booktique

Richard Pollnac and Brian Crawford. 2000. Assessing behavioral aspects of coastal resource use. Coastal Resources Center Coastal Management Report # 2226. Coastal Resources Center, University of Rhode Island, Narragansett, Rhode Island. Available at www.crc.uri.edu

Socioeconomic Indicator 6: Number and nature of markets



What is 'number and nature of markets'?

The number and nature of markets is a measure of the number and types of markets where marine products produced in the area of the MPA are purchased and sold. The market is the connection between the producer (e.g. fisher, mangrove harvester) and the consumer (e.g. resident, tourist, hotel owner). The market serves both a physical function (i.e. buying, selling, storage, processing) and an economic function (i.e. price, behavior).

Why should this indicator be measured?

Since the livelihood and income of people in the community are linked to markets, it will be important to understand the changing nature of markets. This indicator is particularly useful in determining coastal resident access to markets and capital, which contributes to livelihood opportunities. The MPA can have both positive and negative impacts on markets for coastal resource goods (e.g. fish, mangrove) and services (e.g. tourism, recreational fishing, diving). The positive impacts will be shifts in markets resulting in increased income as demand changes for different goods and services provided by the MPA. The negative impacts will be a reduction in the number of markets as goods and services from the MPA are reduced due to management and potential loss of income.

This indicator allows for measurement of the impact of the MPA on markets for major marine products from the area. It allows for an analysis of changes over time in the supply and demand of major marine products and market channels as a result of MPA management. It is important to recognize that market demands also have an impact on the MPA through economic incentives to participate in illegal and/or unsustainable activities.

What is required to measure the indicator?

- List of key informants to interview
- Survey form
- Interviewers
- Secondary data on major marine products and markets
- Paper/pencil

How are data collected on the indicator?

The data can be collected through either a key informant survey of representative fishers and traders or through a survey of fishers and traders. Secondary data on these major marine products may be available in the MPA management plan, economic studies of the region, and from government agencies such as Fisheries, Environment and Natural Resources or Tourism Departments.

Since the market may vary from product to product, there is a need to identify each one. For example, the market for lobster may be different than finfish.

As a first step, the major marine products (i.e., fish, shellfish, crabs, mangrove) in the area of the MPA need to be identified. The key questions might include:

1. What are the ten most important vertebrates harvested? Note local and scientific names.
2. What are the ten most important invertebrates harvested? Note local and scientific names.
3. What are the five most important flora harvested? Note local and scientific names.

The data collection should focus on only the major marine products as the analysis can get complicated the more products that are included.

For each resource, it is important to understand the harvest patterns, importance and marketing. Important questions to ask might include:

1. What time of year is the resource harvested? (month)
2. Where is the resource harvested? (inshore, reef, offshore, distant waters)
3. What is the importance, in terms of value and quantity, of each resource. Rank 1 through 10.
4. What is the resource primarily gathered for? Household consumption, trade/barter, or sale in the market.
5. If the resource is sold, where is the market located? (local, regional, national, export) and to whom? (wholesaler, retailer, transporter, processor).

To supplement the information collected above, for each product, ask the key informant to rank the degree of demand for the product using the following scale:

1 = little or no established market exists for the product; never sold or traded
2 = limited demand for the product; can occasionally sell some
3 = some demand for the product; can sometimes sell it
4 = strong demand for the product; can usually sell it
5 = very strong demand for the product; can always sell it

How are results interpreted and shared?

A written narrative should be prepared for each product describing the harvest patterns, importance and marketing system. A summary table can be prepared that compares important market characteristics for each product. This information can be presented on a map showing the flow or movement of each product from harvest to consumer along the market channel.

Outputs

- A narrative identifying the major marine products in the area and harvest and marketing for these products.
- Summary table of important market characteristics of each product.
- Map showing market channel flow or movement of each product.

Strengths and Limitations of this indicator

	Strength	Weakness
Measurable	+	
Consistent	+	
Precise	+	
Sensitive	+	
Simple		-

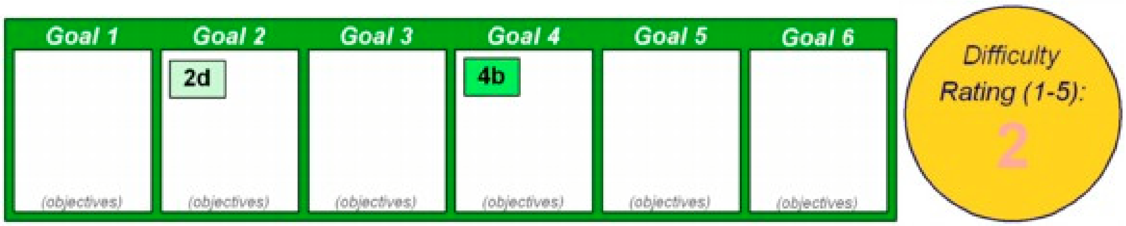
Example

[to be inserted]

Useful References and Other Information:

L. Bunce, P. Townsley, R. Pomeroy and R. Pollnac. 2000. Socioeconomic manual for coral reef management. Australian Institute of Marine Science. Townsville, Queensland, Australia. Available on www.reefbase.org

Socioeconomic Indicator 7: Infant mortality rate



What is ‘infant mortality rate’?

The infant mortality rate is a measure of the number of children that die before a certain age.

Why should this indicator be measured?

Information on the infant mortality rate is used to indicate the general nutrition and health care of people in the community and the quality of life and relative wealth of people in the community. It has been stated that, “No statistic expresses more eloquently the differences between a society of sufficiency and a society of depravation than the infant mortality rate”. If the MPA is providing improvements in livelihood and income, and overall improvements in wealth in the community, then it could be expected that the infant mortality rate should decrease.

What is required to measure the indicator?

- Information on infant mortality rate from secondary source
- Paper/pencil
- Interviewer

How are data collected on the indicator?

Secondary sources, such as the local health department, community nurse or doctor, or local hospital or health care center, provide this information for the local context, but it is most likely aggregated for some larger area. Regional health services may have the disaggregated data which could be used to calculate an index for the local context. At least a five-year series of data should be used. Key informants (mayor, doctor, nurse, midwife, town health department) can be contacted to provide an explanation of reasons for and changes in the infant mortality rate.

When secondary sources are not available, the information could be collected by interviewing key informants (mayor, doctor, nurse, midwife, town health department) and asking them to provide a general description about infant mortality rates in the community.

Additional information that could be collected is the occurrence of diseases in the area. Key informants (mayor, doctor, nurse, health department) should be interviewed to identify major and minor diseases in the area. They might be asked:

- What are the 5 major diseases in the community?
- What were the 5 major diseases in the community ten years ago?
- If there is a change, what was done to address the disease problem?
- What is being done to address the disease problem?

How are results interpreted and shared?

The data is collated and presented in a narrative format. For example:

> The town of Bontoc had an infant mortality rate of 10 infant deaths per 1000 births in 2001. Five years ago (1996), the infant mortality rate was 18 infant deaths per 1000 births. In 1999, a health clinic staffed by a nurse was established in the community. The nurse provides minor medical care and midwife services. A doctor visits the clinic one day per week.

Outputs

- narrative presentation of infant mortality rate in the community

Strengths and Limitations of this indicator

	Strength	Weakness
Measurable	+	
Consistent	+	
Precise	+	
Sensitive	+	
Simple	+	

Example:

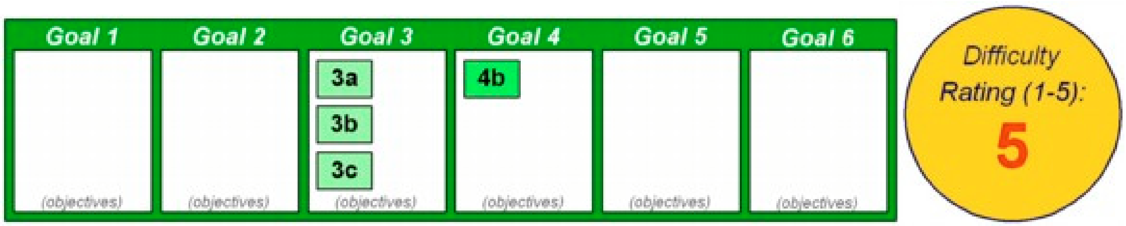
[to be inserted]

Useful References and Other Information:

Richard Pollnac. 1998. Rapid assessment of management parameters for coral reefs. Coastal Resources Center Coastal Management Report # 2205. Coastal Resources Center, University of Rhode Island, Narragansett, Rhode Island. Available at www.crc.uri.edu

L. Bunce, P. Townsley, R. Pomeroy and R. Pollnac. 2000. Socioeconomic manual for coral reef management. Australian Institute of Marine Science. Townsville, Queensland, Australia. Available on www.reefbase.org

Socioeconomic Indicators 8 & 9: Perceptions of non-market and non-use value of the MPA



What is 'perceptions of non-market and non-use value of the MPA'?

Perceptions of non-market and non-use value of the MPA is a measure of how individuals think about the value of coastal resources that are not traded in the market (non-market) and the value of the resources to the portion of society that does not use the resources (non-use). It provides information on community member's perceptions of the value of the MPA and coastal resources.

Why should this indicator be measured?

Non-market values are the economic value of activities that are not traded in any market, which includes direct uses, such as divers who have traveled to the MPA by private means; and indirect uses, such as biological support in the form of nutrients, fish habitat and coastline protection from storm surge. Non-use values represent values that are not associated with any use and include existence value (the value of knowing that the resource exists in a certain condition), option value (the value of being able to use the resource in the future) and bequest value (the value of ensuring the resource will be available for future generations).

This information is useful in order to:

- Understand the value of the MPA in non-monetary, terms which can be used to evaluate the tradeoffs between alternative development, management and conservation scenarios;
- Demonstrate the importance of the MPA to the larger population by calculating the value of the resources to people; and
- Understand the changing value of the MPA to stakeholders over time.

What is required to measure the indicator?

- Survey form
- List of households to survey
- Simple statistical analysis (computer and spreadsheet software)
- Interviewers
- Economist to provide specialist assistance (optional)
- Paper/pencil

How are data collected on the indicator?

The concepts of non-market and non-use values are largely abstract and theoretical. The economic methods used are too complex to be carried out without thorough training. As such, when an economist is not available, an alternative approach using scale analysis is recommended.

The approach is to obtain community members' perceptions of the value of the MPA and coastal resources. A sample of households in the community are interviewed. Each respondent is asked to indicate the degree of their agreement or disagreement with a series of statements. These could include statements about beauty, about looking after the sea for their children's children, about "enjoying time on the water", and about other non-extractive goods and services that a "healthy" marine environment can provide. Each individual MPA will need to decide the specific wording of the questions. An example of questions that involve some aspect of relationships between coastal resources and human activities include:

1. The reefs are important for protecting land from storm waves (indirect non-market value).
2. In the long-run fishing would be better if we cleared the coral. (indirect non-market value)
3. Unless mangroves are protected we will not have any fish to catch.(indirect non-market value)
4. Coral reefs are only important if you fish or dive. (existence non-use value)
5. I want future generations to enjoy the mangroves and coral reefs. (bequest non-use value)
6. Fishing should be restricted in certain areas even if no one ever fishes in those areas just to allow the fish and coral to grow (existence value)
7. We should restrict development in some coastal areas so that future generations will be able to have natural environments (bequest value)
8. Seagrass beds have no value to people (existence value)

Note that the statements are written such that agreement with some indicates an accurate belief, while agreement with others indicates the opposite. This was done to control for responses where the respondent either agrees or disagrees with everything. Statements are randomly arranged with respect to this type of polarity. Respondents are asked if they: very strongly disagree, strongly disagree, disagree, neither disagree or agree (are neutral), agree, strongly agree or very strongly agree with each statement. This results in a scale with a range from one to seven.

How are results interpreted and shared?

Percent distribution of responses to the statements are calculated and reported in a table. Polarity of the statement is accounted for in the coding process, so as a score value changes from one to seven it indicates an increasingly stronger and more accurate belief concerning the content of the statement.

Table. Example of percent distribution of scale values

Statement No.	One	Two	Three	Four	Five	Six	Seven
1	-	06	-	18	05	45	26
2	03	11	03	23	-	33	27
3	-	-	-	06	03	61	30
4	06	35	-	39	02	17	02
5	14	32	06	17	02	18	12
6	18	44	-	06	02	17	14
7	03	11	-	35	-	36	15
8	-	08	-	29	06	39	18

A more complete analysis can be conducted on the data using more advanced statistical methods. The scale values associated with the 8 attitude statements on relationships between coastal resources and human activities can be factor-analyzed, using the principal component analysis technique and varimax rotation. The scree test can be used to determine optimum number of factors to be rotated. Factor scores were created representing the position of each individual on each component.
Where resources are available, it may be possible to use more advanced economic tools to value coastal and marine resources. A number of methods are available depending upon the situation and the data needs. The main methods and approaches discussed are generally and potentially applicable in developing countries (but also of use in developed countries).

Economic valuation measurement and valuation techniques

Generally Applicable	Potentially Applicable	Survey Based
Those that use the market value of directly related goods and services: - change in productivity - loss of earnings - opportunity cost	Those that use surrogate-market values: - property values - wage differential - travel cost - marketed goods as proxies	Contingent valuation
Those that use the value of direct expenditures: - cost-effectiveness - preventive expenditures	Those that use the magnitude of potential expenditures: - replacement cost - shadow project	

Outputs

- table on percent distribution of scale values

Strengths and Limitations of this indicator

The main limitation of this indicator is that the concepts of non-market and non-use values are largely abstract and theoretical. As a result, the economic methods usually employed are too complex to be carried out without thorough training. The approach presented above is a simpler technique for obtaining information on people’s perceptions of value of the MPA and coastal resources, although it still involves more advances analytical skills to conduct. The indicator may require infrequent specialist studies, such as from an economist.

	Strength	Weakness
Measurable	+	
Consistent	+	
Precise		-
Sensitive	+	
Simple		-

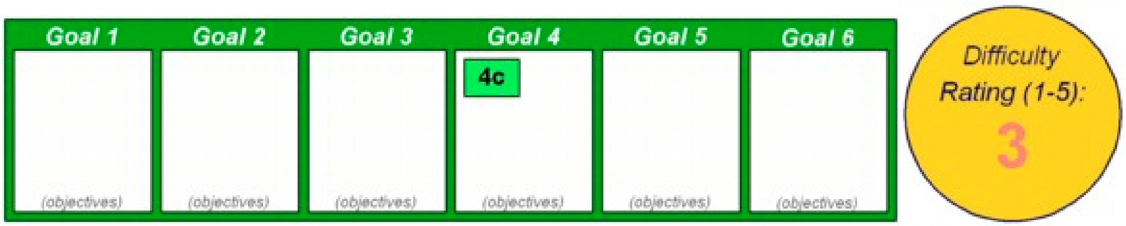
Example

[to be inserted]

Useful References and Other Information:

L. Bunce, P. Townsley, R. Pomeroy and R. Pollnac. 2000. Socioeconomic manual for coral reef management. Australian Institute of Marine Science. Townsville, Queensland, Australia. Available on www.reefbase.org   See page 224, Non-market and non-use values.

Socioeconomic Indicator 10: Percentage of particular stakeholder group in leadership positions



What is 'percentage of stakeholder group in leadership positions'?

The percentage of stakeholder groups in leadership positions measures the number of individual stakeholders from the various stakeholder groups who have been or currently are in a leadership position related to MPA management.

Why should this indicator be measured?

This indicator is important to collect because it provides an understanding of the degree of equity among social groups associated with the MPA. If a range of stakeholders (especially those from minority groups) are involved in leadership positions in MPA management, a broader representation of ideas and interests is achieved; a more democratic and equitable management structure is in operation; and a greater level of participation in management is achieved. If all stakeholder groups are not represented, recommendations can be made to include non-represented stakeholder groups in a leadership position in MPA management.

What is required to measure the indicator?

- Survey form
- Interviewers
- List of leaders and representatives of stakeholder groups to survey
- MPA management plan and organizational chart
- Paper/pencil

How are data collected on the indicator?

First, obtain a copy and review the organizational structure of the MPA management. Second, identify the representative structure of stakeholder groups from the organizational structure. Third, through a key informant interview of MPA management, identify the stakeholder groups and the representatives of the stakeholder groups to MPA management, both previous and current. Four, through a key informant interview of MPA management and known stakeholder groups, prepare a listing of all stakeholder groups associated with the MPA. Cross-check the list with information provided by the stakeholder groups to identify leaders and representatives. If there is difficulty in identifying the stakeholder groups through key informants, a stakeholder analysis can be conducted (for methods of conducting stakeholder analysis see Governance Indicator Number 5: Degree of Stakeholder Participation in Management of MPA). Fifth, Interview each leader and representative in order to describe their stakeholder group history and the role of their group in MPA management. Sixth, check to see if all stakeholder groups identified through the stakeholder analysis are represented in MPA management. If a stakeholder group is not represented in MPA management, ask why it is not represented and if it has plans to be represented. It is important to measure this indicator over time as stakeholder groups and representatives may change.

How are results interpreted and shared?

The total number of stakeholder groups associated with the MPA are identified and presented in a table. The percentage of this total number of stakeholder groups that have been, or currently are, in leadership positions is calculated and presented in a table. A narrative is prepared to accompany the tables that describes the history and role of stakeholder group representation and leadership in MPA management.

Outputs

- Table of total number of stakeholder groups that have been, or currently are, in a leadership position in MPA management.
- Accompanying narrative describing the history and role of stakeholder group representation and leadership in MPA management.

Strengths and Limitations of this indicator

A strength of this indicator is that it provides a measure of the percentage of stakeholder groups represented in leadership positions in MPA management. However, the indicator will not measure the "power" each stakeholder group has in MPA management. It should be noted that some stakeholder groups may not have defined representation procedures to select their representatives or may not be organized enough to have representation.

	Strength	Weakness
Measurable	+	
Consistent	+	
Precise	+	
Sensitive	+	
Simple	+	

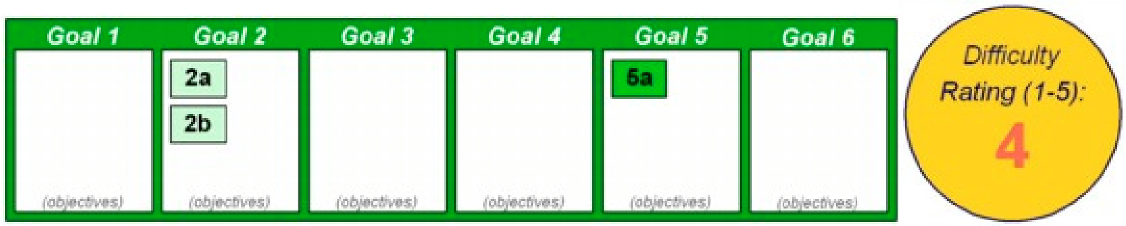
Example

[to be inserted]

Useful References and Other Information:

S. Langill (compiler) 1999. Stakeholder Analysis. Volume 7. Supplement for Conflict and Collaboration Resource Book. International Development Research Center, Ottawa, Canada.

Socioeconomic Indicator 11: Local marine resource use patterns



What is "local marine resource use patterns"?

Local marine resource use patterns are the ways people use or affect coastal and marine resources.

Why should this indicator be measured?

By understanding local marine resource use patterns it is possible to determine whether or not management strategies are impacting income and livelihood patterns and cultural traditions. MPA managers can also use this information on local marine resource use patterns to determine what coastal and marine related activities have been affected by the MPA and consequently who may benefit and who may lose from the MPA. This information can be used to try to minimize impacts on the MPA. This information also provides an understanding of potential threats to the MPA.

The degree of compliance and MPA success is influenced by the patterns of local use present within the area. Consequently, understanding local use patterns will help the MPA manager increase support for the MPA and minimize the impacts on resource users by ensuring the formal MPA design is consistent with exiting informal patterns of marine resource use.

What is required to measure the indicator?

- interviewers
- notebook and pen
- global positioning system device
- base map of area

How are data collected on the indicator?

The "area" for identifying marine resource use patterns is defined as the MPA and the immediately adjacent coastal and marine zone.

The data on local marine resource use patterns should be collected first through secondary data from government sources, including village and town offices; and national agency reports, maps, statistical reports, and official regulations. Then through primary data collection from focus groups, semi-structured interviews, structured surveys and observations. Visualization techniques are also useful and include:

- Local classifications – to clarify the marine resource uses and associated species;
- Maps – to show the location of activities, residence of stakeholders, and use rights;
- Timelines – to show when activities occur and the seasonality of events; and
- Drawings – to show different marine resource-related activities.

The data collection begins by collecting information on the marine related activities, which includes activities that directly or indirectly affect marine resources (both land- and sea-based activities). This information will help in understanding the other sub-parameters. Key questions to address include:

1. What marine related activities are taking place at sea?
2. What reef related activities are taking place on land?
3. What impacts are these activities having on marine resources?

Next, the stakeholders, including the type and number of primary and secondary stakeholders, and their basic characteristics need to be understood. Important questions include:

1. Who is conducting these uses?
2. How many people are conducting each use ?
3. What are their basic characteristics (e.g. gender, residency status, age)?

The techniques for marine related activities need to be understood including technology used, techniques for applying the technology, and ways people organize themselves in these activities. Key questions include:

1. How are the uses conducted?
2. What technology is used and how much is used?
3. How is the equipment constructed and who owns it?
4. How do these methods affect the marine resources?
5. How are people organized to use marine resources?

The boundaries of the community area need to be understood. This involves asking where are the political, biological/ecosystem, physical/oceanographic, fishing areas, social/cultural, and traditional/customary boundaries.

The location of marine related activities and stakeholders is also important to understand. Key questions include:

1. Where do these marine related activities occur?
2. Where do stakeholders live and work?
3. Where are the marine resources located for comparison?

Finally, it is important to understand the timing and seasonality of activities, including the daily, weekly and monthly patterns of resource use, seasonal changes and long-term trends in resource use. Key questions include:

1. When do the uses take place and what changes occur at particular times?
2. Why do these changes in use occur?

How are results interpreted and shared?

The results are presented in a narrative form with accompanying tables, figures, and diagrams to clarify and highlight points. The focus of the data analysis and presentation is around the major marine related activities identified in through the data collection. Summarize the relevant information on the other sub-parameters for each activity. Diagrams can be drawn from the visualization techniques. The descriptions may also include quantitative data.

Outputs

- A narrative describing the major marine related activities, with tables, figures, and diagrams to clarify and highlight points.
- Summaries of other sub-parameters with tables, figures, and diagrams to clarify and highlight points.

Strengths and Limitations

The major limitation of this indicator is that it involves a great deal of preparation and use of several types of data collection methods. Furthermore, it is time consuming and costly. However, if done well, the indicator can provide very useful and important information for management.

	Strength	Weakness
Measurable	+	
Consistent	+	
Precise		-
Sensitive	+	
Simple		-

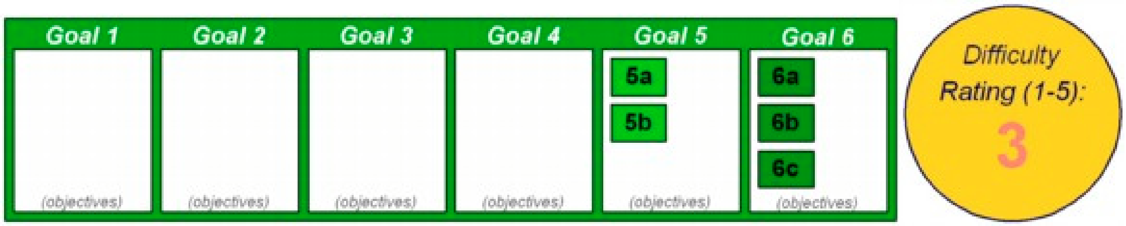
Example

[to be inserted]

Useful References and Other Information:

Leah Bunce, Philip Townsley, Robert Pomeroy and Richard Pollnac. 2000. Socioeconomic manual for coral reef management. Australian Institute of Marine Science, Townsville, Queensland, Australia. Available on www.reefbase.org

Socioeconomic Indicator 12: Local values and beliefs regarding the marine resources



What are 'local values and beliefs'?

Local values and beliefs regarding the marine resources are measures of how people make choices and undertake actions related to marine resource use and management based on their values about what is good, just and desirable and their beliefs of how the world works. A value is a social more or norm manifested as a result of, history and culture. It is a shared understanding among people of what is good, desirable, or just. A belief is a shared understanding by members of a group or society of how the world works.

Why should this indicator be measured?

In a MPA context, managers are interested in how values and beliefs related to marine resources, their use, and management practices influence behavior within the stakeholder group or society. Local values and beliefs therefore influence people's behavior and assist in forming customary practices. Depending on the structure and orientation of values and beliefs they may undermine or enhance management efforts and the success of the MPA. Consequently, understanding this indicator can help a manager to more effectively integrate people's local values and beliefs into the MPA management structure and thereby minimize adverse effects of management.

What is required to measure the indicator?

- survey form
- list of households to survey
- interviewers
- notebook and pen

How are data collected on the indicator?

Through a survey of households, respondents are asked a series of questions about their perceptions related to their values and beliefs on marine resources, their use, and management.

To understand values and perceptions regarding use and management respondents might be asked questions such as:

1. Why is/are the sea/mangroves/coral reefs important to you?
2. Why is/are fishing/diving/other activities important to you?
3. Does (destructive activity – e.g. bomb fishing) hurt the resource?
4. Why do people conduct this (destructive activity)?
5. What do you think of current MPA management strategies?
6. Do the current MPA management strategies compliment local cultural beliefs and traditions?

Any stories or anecdotes that illustrate their thoughts should be recorded.

As an example, Pollnac and Crawford (2000) questioned households in North Sulawesi, Indonesia regarding their perceptions of bombfishing and why they use this technique. Respondents were asked:

1. Does bomb fishing hurt the resource? Yes___ No___
2. Why do fishers bomb fish?

To further assess values and beliefs of regarding the resources, the respondent can be asked to indicate the extent to which they agree with the following statements:

- We have to take care of the land and the sea or they will not provide for us in the future.
- We do not have to worry about the sea and the fish; God will take care of it for us.
- We should manage the sea to ensure that there are fish for our children and their children.

Respondents are asked if they very strongly agree, strongly agree, agree, neither agree nor disagree (neutral), disagree, strongly disagree, or very strongly disagree. This results in a scale with a range of one to seven.

How are results interpreted and shared?

The percent distribution of responses are calculated. For the example on bomb fishing above, a table showing percent distribution of responses is prepared.

Table. Percent distribution of responses to whether bomb fishing hurts the resource

	Yes	No
Bentenan	88	12
Tumbak	96	4
Rumbia	94	6
Minanga	94	6

Table. Percent distribution of the perception that bomb fishers fish that way because it is a quick/easy way to obtain fish/money.

	No	Yes	Total	N
Bentenan	61	39	100	66
Tumbak	64	36	100	56

Rumbia	56	44	100	52
Minanga	62	38	100	50
Total	61	39	100	
N	136	88		224

A narrative explanation of the results is prepared. For example:

> A large majority of respondents agree with the statement that bomb fishing hurts the resource. The largest percentage of respondents who said it did not hurt the resource was from Bentenan. As to why fishers use the technique, the most frequent response category is that it is a quick and/or easy way to obtain lots of fish and/or money (39 percent of respondents used this response).

The local values and beliefs of the stakeholders with regard to marine resources and their management are illustrated by a high degree of compatibility between local values and beliefs and the goal and objectives of the MPA. A high level of compatibility is indicated by local values and beliefs being reflected in the MPA goal and objectives developed in a participatory manner and local support for the MPA.

Outputs

- tables of percent distribution of perception of values and beliefs.
- narrative explanation of statistical results.

Strengths and Limitations

	Strength	Weakness
Measurable	+	
Consistent	+	
Precise		-
Sensitive	+	
Simple		-

Example

[to be inserted]

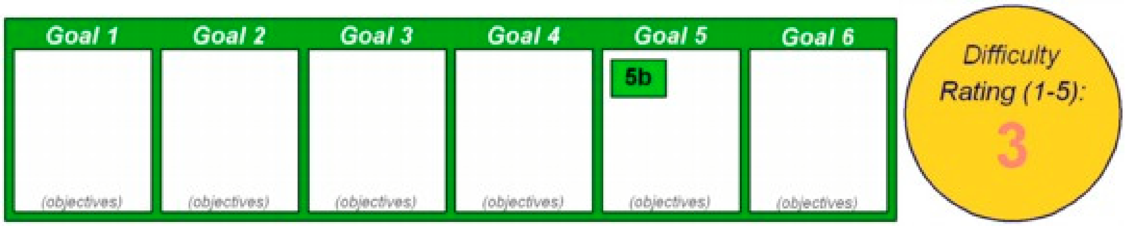
Useful References and Other Information:

Leah Bunce, Philip Townsley, Robert Pomeroy and Richard Pollnac. 2000. Socioeconomic manual for coral reef management. Australian Institute of Marine Science, Townsville, Queensland, Australia. Available on www.reefbase.org

W. Kempton, J.S. Boster, and J.A. Hartley. 1995. Environmental Values in American Culture. Boston: MIT Press.

Pollnac, R.B. and B.R. Crawford. 2000. Assessing behavioral aspects of coastal resource use. Proyek Pesisir Publication Special Report. Coastal Resources Center, Coastal Management Report #2226. Coastal Resources Center, University of Rhode Island, Narragansett, Rhode Island.

Socioeconomic Indicator 13: Changes in conditions of ancestral and historical sites, features, and/or monuments



What are 'changes in conditions of ancestral and historical sites, features, and/or monuments'?

Changes in conditions of ancestral and historical sites/features/monuments is a measure of the significance, presence and use of material features that have at some point in time become significant for a society's culture and history.

Why should this indicator be measured?

This indicator can be used to measure impacts of the MPA and its activities, such as increased tourism, on the ancestral and historical site/feature/monument. This is important to maximizing compatibility between the MPA management and local culture. The information generated by the indicator can be used for interpretive programs and for raising cultural awareness and/or sensitivity. This indicator provides feedback on the level of knowledge about any site/feature/monument, as well as its condition to assess how well the MPA contributes to preserving the community's and society's culture and history.

What is required to measure the indicator?

- map of area
- camera
- survey form
- interviewers
- notebook and pen
- global positioning system device

How are data collected on the indicator?

First, a base map of the land and sea area around the MPA is prepared. Second, all ancestral and historical sites/features/monuments on the land and sea are identified on the map. Third, historical profile information should be collected. This involves addressing the following questions:

1. What is the historical importance of the site?
2. What local folklore is associated with the site?

3. What is the condition of the site?
4. What is the level of restoration of the site?
5. What is the level of access to the site?
6. What is the level and availability of interpretive materials?

Information on these sites/features/monuments can come from many sources. Secondary data available in libraries on the history of the area. Interviews are conducted with local government officials, national museums, community historians, and national or university archeologists. Interviews are also conducted with local key informants, such as elders and traditional leaders, to identify these sites/features/monuments. Local fishers may need to be interviewed to locate sites/features/monuments at sea. It should be noted that many traditional sites to the community, such as burial grounds, will need to be identified.

In addition, photographs should be taken from all angles and sufficiently close to show details of wear and tear. A scale can be used to rank the condition of the site/feature/monument. A 1 to 10 scale can be used where 1 is very poor/deteriorating condition and little knowledge of the site/feature/monument and 10 is excellent condition and high knowledge about site/feature/monument.

A survey of the site/feature/monument should be conducted at least every five years unless a major event, such as a natural event (hurricane, flooding), change in access, or change in cultural attitude, has occurred.

How are results interpreted and shared?

A narrative text describing the sites/features/monuments is prepared. It should include location on the map, detailed photographs, and copies of significant secondary source publications/documents (e.g. brochures, historic documents).

Outputs

- narrative text describing the site/feature/monument

Strengths and Limitations

A limitation to this indicator is that access to the site may be difficult. Another challenge is identifying all the important sites/features/monuments. This may require understanding the local culture and talking to knowledgeable local residents about these areas. This indicator may have limited application in many places, but useful in other places, such as a World Heritage Site, where culture is a major factor.

	Strength	Weakness
Measurable	+	
Consistent	+	
Precise	+	
Sensitive	+	
Simple		-

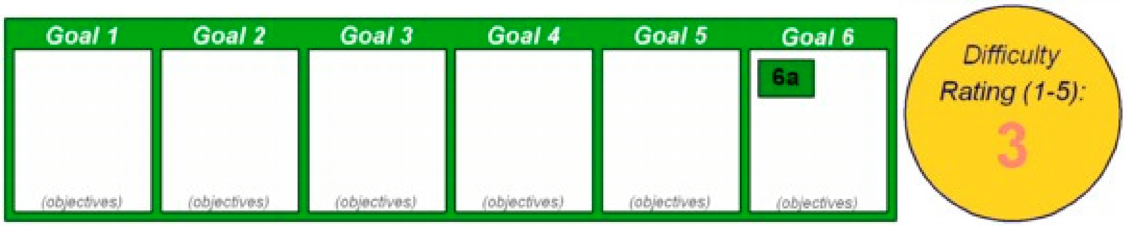
Example

[to be inserted]

Useful References and Other Information

T.R. McClanahan, H. Glaesel, J. Rubens and R. Kiambe. 1997. The effects of traditional fisheries management on fisheries yields and the coral reef ecosystems of Southern Kenya. Environmental Conservation. 24(2): 105-120.

Socioeconomic Indicator 14: Stakeholder knowledge of natural history



What is 'stakeholder knowledge of natural history'?

Stakeholder knowledge of natural history (here referred to as traditional knowledge) is a measure of the knowledge held by stakeholders that is not based on scientific research but comes from stakeholder observations, experiences, beliefs and perceptions of cause and effect. It is also the degree to which local stakeholders pass on to next generations ecological knowledge and beliefs regarding the natural environment and the effects of human use.

Why should this indicator be measured?

It is important to measure stakeholder knowledge because it allows the manager to see if the MPA is enhancing community respect and/or understanding of traditional knowledge. Stakeholder knowledge of natural history is also used by MPA managers to:

- Contribute to their scientific understanding of marine resources, e.g. local fishers may advise on reef fish behavior, habitat and migration patterns;
- Facilitate interactions with stakeholders by ensuring the managers know as much as the stakeholders, since fishers may not respect a manager if he or she is not as knowledgeable about marine resources as the locals; and
- Facilitate accurate communication and data collection by ensuring the managers, scientists and stakeholders use the same terms.

MPA compliance and success may be influenced by changes in the distribution of traditional knowledge and awareness among the stakeholders of natural history and biological event timing across generations, gender, and community roles and positions. In order for people to take action to protect and manage the environment, they need to understand how the natural ecosystem works. Those with higher levels of knowledge of natural history tend to be more receptive to management initiatives, such as a MPA, and provide more support for the MPA.

What is required to measure this indicator?

- survey form
- interviewer
- list of households to survey
- notebook and pen
- map of area

How are data collected on the indicator?

The focus of this indicator is folk taxonomy and local knowledge of resources. Folk taxonomy involves understanding the local names of marine aquatic resources, locations of the resources and related activities, particularly significant places such as fishing grounds and landing sites, and related activities around the resources. Important questions to address may include:

1. What are the local names of the marine resources?
2. What the local names of where they are located?
3. What are the local names of particularly significant places related to the resources (e.g. spawning sites)?
4. What are local names of activities related to the resources?

This involves understanding how these items are classified, e.g. while scientists may divide fauna into families and species using scientific criteria, stakeholders may use very different groups such as edible/non-edible, species that live in similar environments, seasonal availability, etc.

Local knowledge refers to stakeholder understanding of the marine aquatic resources including: the location of resources, their mobility, quantity, interactions among resources, feeding behaviors, and breeding behaviors and locations. Key questions may include:

1. Where are the resources located?
2. What is the extent of their mobility?
3. What is the population size of each resource?
4. What kinds of interactions are there among resources?
5. What are feeding behaviors of the resources? Breeding behaviors and locations?

This knowledge also involves understanding how these characteristics have changed over time and why. Local knowledge may be limited to commercially important species, with which stakeholders are often most familiar.

Variations in knowledge may occur. This refers to the range of perceptions among different stakeholders, e.g. fishers may know more about changes in the fish populations because they harvest these resources; whereas divers may be more familiar with coral conditions since they see the corals while diving.

Folk taxonomy should be assessed first because it will provide important information for local knowledge and variations in knowledge. It will probably be found that there is little secondary data on traditional knowledge, which is often passed on by word of mouth from generation to generation.

A range of data collection methods and visualization techniques can be used. Semi-structured interviews, oral histories, surveys, observations and focus group interviews are all important for collecting information. During the data collection it is particularly important to record who the informants are and their characteristics (e.g. age, gender), which will be used to assess variations among people and stakeholder groups.

Visualization techniques include:

- Local classifications to identify local taxonomies;
- Ranking matrices to assess variations among individuals and stakeholder groups; and
- Ranking matrices and timelines to encourage discussion and analysis of changes in resource abundance or other features of local knowledge where relative quantities are important.

It is also important to measure through semi-structured interviews with MPA managers:

- Their awareness of stakeholder knowledge of natural history;
- Their use of this knowledge; and
- The interaction and consistency of local stakeholder knowledge and scientific knowledge.

How are results interpreted and shared?

The data should be summarized into descriptive text based on the qualitative information and quantitative data. Table and figures can clarify and illustrate variations and trends, e.g. knowledge of place names and beliefs about distributions of flora, fauna, and minerals can be put on maps; ranking matrices and timelines created by informants during field data collection can be included to show stakeholder knowledge and perceptions of resource conditions and changes.

Analysis of variations is unique and involves comparing responses from informants to determine the basis of their differences. By comparing the responses on local taxonomies and local knowledge with the informants' basic characteristics, the team can determine the socioeconomic basis of their differences, e.g. variation may be related to area of residence or work experience.

Outputs

- A narrative text on each sub-parameter such as folk taxonomy and local knowledge
- Table and figures to clarify and illustrate variations and trends
- Maps showing location of resources
- Ranking matrices and timelines showing stakeholder knowledge and perception of resource conditions and changes

Strengths and Weaknesses

An appreciation of local traditional knowledge by managers and scientists is needed. It is important to note that local traditional knowledge is variable. For example, a spear or handline fisher usually has greater knowledge than a deck hand on a trawler. While some local resource users may have an extensive knowledge of marine organism life history and behavior, a lot of traditional knowledge is based in (or flavored by) mythology, religion, etc. and is inaccurate. Traditional knowledge often includes a lot of spurious reasoning for observed patterns. While traditional knowledge is important and can be very useful, caution must be used and the information should be checked with others in the community and with scientific experts.

	Strength	Weakness
Measurable	+	
Consistent	+	
Precise		-
Sensitive	+	
Simple		-

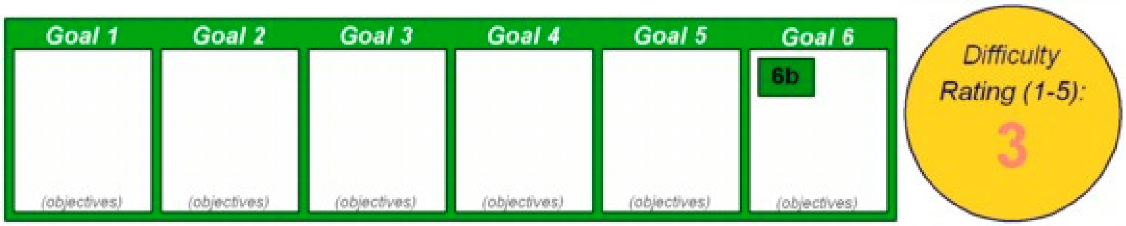
Example

[to be inserted]

Useful References and Other Information

Leah Bunce, Philip Townsley, Robert Pomeroy and Richard Pollnac. 2000. Socioeconomic manual for coral reef management. Australian Institute of Marine Science, Townsville, Queensland, Australia. Available on www.reefbase.org pp. 202-204 in Chapter 6. Traditional Knowledge.

Socioeconomic Indicator 15: Level of understanding of human impacts (including population) on resource.



What is 'level of understanding of human impacts on resource'?

Level of understanding of human impacts (including population) on resource is a measure of the degree to which local stakeholders understand basic ecological relationships and the impacts that human activities have on the natural environment.

Why should this indicator be measured?

An understanding of individual perceptions of factor influencing the status of marine resources can be used to identify the distribution of faulty, as well as accurate, perceptions. The knowledge regarding these distributions can then be used to structure interventions designed, for example, to involve the community in the management of its resources, and to evaluate the changes resulting. This could lead to improved human use patterns and help to target environmental education program to user groups and stakeholders.

What is required to measure the indicator?

- survey form
- interviewers
- list of households to survey
- notebook and pen

How are data collected on the indicator?

An assessment is conducted of stakeholder perceptions about the extent to which they believe their own activities affect the natural environment. Questions are asked using a semi-structured interview or focus group, which addresses threats to the natural environment and changes in the natural environment due to the threats. The questions might include:

1. What events, activities or changes do you feel have affected or are affecting the natural environment?
2. What changes in the natural environment do you attribute to these threats?
3. How do you compare the threats in terms of levels of impact?

Visualization techniques are particularly important when assessing stakeholder perceptions because they provide visual and oral ways of communicating ideas. Several visualization techniques can be used, including maps and transects, decision trees, Venn diagrams, and flow charts.

How are results interpreted and shared?

Narrative text descriptions of the question are prepared based on the relevant data and responses. These data are often qualitative, including anecdotes, stories, historical accounts and legends, informant observations of apparent causes and effects, and opinions regarding how the natural environment should and should not be used. Important points in the text are illustrated with diagrams from the visualization techniques that ensure that stakeholder perceptions are being accurately presented.

The level of understanding of the extent to which stakeholders believe their own actions affect the natural environment and their level of environmental awareness are measured and described.

Outputs

- Narrative text
- Maps and transects, decision trees, Venn diagrams, and flow charts

Strengths and Limitations

Stakeholder perceptions are difficult parameters to assess because people's perception's, opinions and attitudes are highly variable and often there are few secondary data on stakeholder perceptions.

	Strength	Weakness
Measurable	+	
Consistent		-
Precise		-
Sensitive	+	
Simple		-

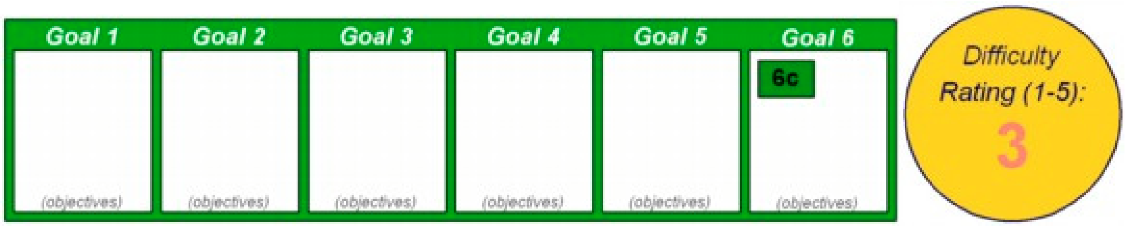
Example

[to be inserted]

Useful References and Other Information

Leah Bunce, Philip Townsley, Robert Pomeroy and Richard Pollnac. 2000. Socioeconomic manual for coral reef management. Australian Institute of Marine Science, Townsville, Queensland, Australia. Available on www.reefbase.org

Socioeconomic Indicator 16: Distribution of formal knowledge to community



What is 'distribution of formal knowledge to community'?

Distribution of formal knowledge to community is a measure of the degree of awareness in information generated by the scientific community held by stakeholder and user groups regarding MPA use and ecosystem impacts.

Why should this indicator be measured?

The information generated by this indicator can help to contribute to improved scientific understanding of local ecosystems and to facilitate interactions with stakeholders by ensuring the stakeholders have confidence in the scientific information. It can also facilitate accurate communication and data collection by ensuring the managers, scientists and stakeholders use the same terms. As a result, rewritten, interpreted, translated, disseminated/communicated, and ideally understood scientific information can lead to meaningfully applied and managed MPAs.

What is required to measure this indicator?

- Survey form
- Interviewers
- list of households to survey
- notebook and pen
- map of area

How are data collected on the indicator?

A list of scientific information provided to the community by MPA management and scientists is prepared. This may be material on expected impacts of the MPA, expected changes on resources from the MPA, and impacts from changes in certain use patterns provided at meetings, in publications, or through television and radio. Second, each respondent is asked whether they are aware of this information or not. Third, they are asked to describe the types of scientific information provided to them. Any stories or anecdotes that illustrate their thoughts should be recorded.

Based on these conversations, use the following scale to rank the awareness they have about scientific information.

1 = no awareness of information generated by the scientific community regarding MPA use and ecosystem impacts.
2 = limited awareness of information generated by the scientific community regarding MPA use and ecosystem impacts.
3 = moderate awareness of information generated by the scientific community regarding MPA use and ecosystem impacts.
4 = extensive awareness of information generated by the scientific community regarding MPA use and ecosystem impacts.
5 = complete awareness of information generated by the scientific community regarding MPA use and ecosystem impacts.

Ask a follow-up question about why they do or do not have confidence in the scientific information: To what extent do you believe the scientific information?

Also ask a question about how to improve the information provided to them: How can this information be improved?

How are results interpreted and shared?

The data should be summarized into descriptive text based on the qualitative information and quantitative data. Table and figures can clarify and illustrate variations in the scale ranking of confidence. Include anecdotes and stories, and opinions regarding how the scientific information.

Outputs

- narrative text with text boxes on anecdotes and stories
- tables and figures to clarify and illustrate important points

Strengths and Weaknesses

	Strength	Weakness
Measurable	+	
Consistent		-
Precise	+	
Sensitive	+	
Simple		-

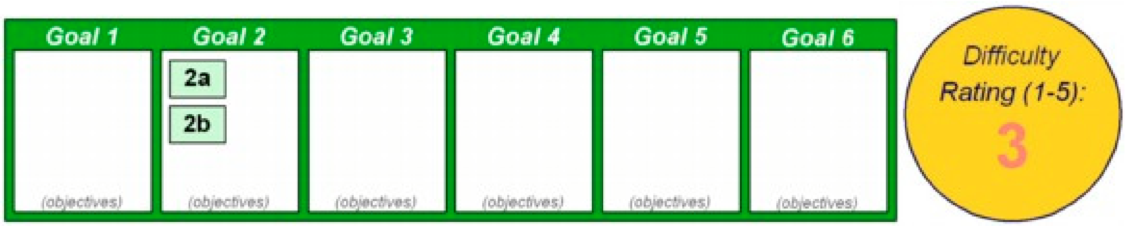
Example

[to be inserted]

Useful References and Other Information

Leah Bunce, Philip Townsley, Robert Pomeroy and Richard Pollnac. 2000. Socioeconomic manual for coral reef management. Australian Institute of Marine Science, Townsville, Queensland, Australia. Available on www.reefbase.org

Socioeconomic Indicator 17: Income distribution by source by household



What is 'Income distribution by source by household'?

Income distribution by source by household is a measure of the principal sources of income for households in the community.

Why should this indicator be measured?

An important part of understanding stakeholder characteristics is household livelihood and sources of income, which includes the way people combine the resources and assets at their disposal to make a living for themselves and their families. An understanding of these livelihood and income sources will allow the MPA manager to better measure and understand the impacts of the MPA on local households. It will allow the MPA manager to understand who is winning and losing, as a result of shifts in household income sources, as a result of the MPA. Shifting sources of income may indicate a positive or negative impact of the MPA on households. Understanding income sources will also enable the manager to determine levels of community dependency on the resources, which can be used to make changes in MPA management to diversity occupational and income structures. For example, if more than 90% of the community is fishermen, then the MPA might offer aquaculture training so they are less dependent on one income.

Also, if households perceive a decrease in the sources of household income over time, than this information can be used to make changes in MPA management to ensure that local households are obtaining adequate livelihood and income. Finally, if households perceive an increase in the sources of household income over time, then this information can be used in support of the MPA.

What is required to measure the indicator?

- Survey form
- Sample of community households to be surveyed
- Interviewers
- Notebook and pen

How are data collected on the indicator?

Secondary data is first collected to determine the main sources of income for households and to sort out a few broad groups of people dependent on particular income sources, such as fishing, farming or dive operations. These day may be available from census bureaus and local government offices. The following secondary data are most often available:

1. Economic status (ownership of key assets such as land, fishing boats) and aspects of social status (particularly membership of formal organizations).
2. Sources of livelihood of community members, which often only cover the principal economic activity of individuals or households (specific information on stakeholder households is often available).

Primary data may need to be collected involving a survey or a semi-structured interview to collect data from a sample of households in the community on different source of household income and different sources of livelihood for households. Questions might include:

1. What are the different sources of income in your household? List all.
2. What is the relative importance of each source of household income in the community? Provide percentage.
3. What are the different types of livelihood of the household? List all.
4. What is the relative importance of each livelihood activity to overall household income? Provide percentage.

This data is collected from a sample of households in the community over time to assess shifting sources of income, especially those related to the MPA, such as fishing, dive operations, and tourism.

How are results interpreted and shared?

Tables of percentages showing the different sources of household income, relative importance of each source of household income in the community, different types of livelihood of the household, and relative importance of each livelihood activity to overall household income are prepared. A narrative text is prepared to explain the quantitative results.

Outputs

- A table of percentages of responses
- Narrative text

Strengths and Limitations of this indicator

A limitation is that the usefulness of this indicator will depend upon the availability and cooperation of the household informant to respond to questions about income, often a sensitive topic.

	Strength	Weakness
Measurable	+	
Consistent	+	
Precise	+	
Sensitive	+	
Simple	+	

Example:

Useful References and Other Information:

Leah Bunce, Philip Townsley, Robert Pomeroy and Richard Pollnac. 2000. Socioeconomic manual for coral reef management. Australian Institute of Marine Science, Townsville, Queensland, Australia. Available on www.reefbase.org

A1-4 The 16 Governance Indicators

Figure 8. The 5 goals and 21 objectives related to the governance indicators.

MPA Goal 1: To ensure effectiveness of marine and coastal resource management structures and strategies.

- **1a** Objective: Effective and implemented resource management planning.
- **1b** Objective: Socially acceptable and clearly defined rules for marine/coastal resource access and use.
- **1c** Objective: Presence of effective and accountable decision-making and management bodies.
- **1d** Objective: Sufficient human and financial resources used efficiently and effectively.
- **1e** Objective: Recognize and incorporate traditional/ local/informal governance in management planning.
- **1f** Objective: Ensure periodic effective monitoring, evaluation, and adaptation of the management plan.

MPA Goal 2: To ensure the effectiveness of legal structures and strategies for marine and coastal resource management.

- **2a** Objective: Ensure the existence of adequate legislation supporting the MPA and its management.
- **2b** Objective: Ensure compatibility between formal legal arrangements and traditional local arrangement.
- **2c** Objective: Ensure that national/local legislation incorporates rights and obligations set out in international legal instruments.
- **2d** Objective: Ensure compatibility of international, national, state, and local rights and obligations.
- **2e** Objective: Ensure enforceability of legislation and management rules/regulations.

MPA Goal 3: To ensure that stakeholders representation and participation in coastal and marine resources management is effective and equitable.

- **3a** Objective: Representative and effective systems of co-management exist.
- **3b** Objective: Build the resource users capacity to participate in co-management arrangements.
- **3c** Objective: Strengthen and enhance community organizing.

MPA Goal 4: To enhance compliance by resources users with management plans.

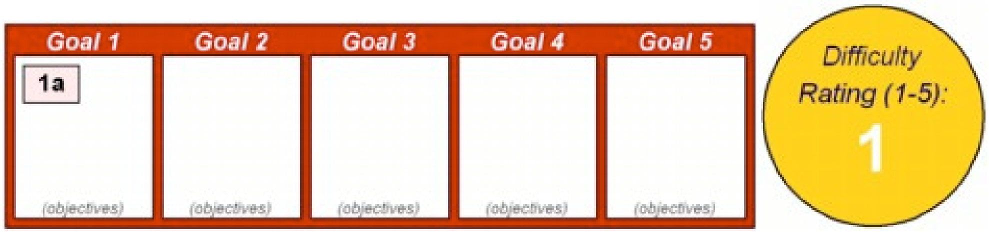
- **4a** Objective: Improve surveillance and monitoring of the MPA and surrounding coastal/offshore areas.
- **4b** Objective: Improve the willingness and acceptance of people to behave in ways that allow for sustainable marine and coastal resources management.
- **4c** Objective: Build the local ability (capacity) to use resources sustainably.
- **4d** Objective: Increase user participation in surveillance, monitoring, and enforcement of the MPA.
- **4e** Objective: Ensure that adequate applications of law and regulations occur/exist.
- **4f** Objective: Ensure the transparency and simplicity of, and the access to, the management plan in order to foster compliance.

MPA Goal 5: To effectively manage marine and coastal resource use conflicts.

- **5a** Objective: To reduce conflicts: (a) within and between user groups, and (b) between user groups and the community or between the community and people outside it.

Figure 11. The 16 governance indicators presented in this guidebook, and their relationship to the 5 governance goals and 21 associated objectives.

Governance Indicator 1: Existence of a management plan and adoption of plan



What is 'existence of a management plan and adoption of plan'?

Existence of a management plan and adoption of plan is a measure of the existence of a document which states the overall MPA goals and objectives to be achieved, the institutional structure of the management system, and a portfolio of management measures.

Why should this indicator be measured?

The MPA management plan sets out the strategic directions for the MPA management program. The effective management of the MPA is based on the achievement of goals and objectives through the use of appropriate management measures. The existence and adoption of a management plan means that there are strategic directions and actions for implementation of the MPA.

What is required to measure the indicator?

- MPA site selected
- Name and address of the MPA manager or management body
- Meeting time and location established to meet with MPA manager
- Management plan
- Paper/pencil

How are data collected on the indicator?

First, seek out the MPA manager and request a copy of the MPA management plan. Second, A checklist is prepared with the following information. Third, the actual existence of plan in printed form is noted. Fourth, the adoption of the plan and date of adoption is noted. Fifth, the management plan is reviewed to determine the date of the current plan, date of any updates, signatories of the plan adoption, level of plan adoption (international, national, regional, municipal, local), and statements of goals, objectives, policies, strategies, management measures, budget and financing.

How are results interpreted and shared?

From the checklist, a narrative text is prepared describing the existence of the plan, its adoption date, and characteristics of the plan.

The existence and adoption of an MPA management plan informs us that the MPA is guided by goals and objectives to achieve certain outcomes (for example, conservation, protection, research), that there is a basic strategy to achieve these goals and objectives, and that the overall plan has a mandate for implementation.

In some cases a formal management plan may not exist but there may be informal or agreed upon goals and objectives by those associated with the MPA. This should be noted and described in narrative text.

Outputs

- narrative text about the management plan

Strengths and Limitations of this indicator

While an MPA management plan may exist, that does not guarantee that it is good or that it is being followed or that its legitimacy is recognized by the local resource users. A bad or inappropriate plan that is implemented may be worse than no plan.

	Strength	Weakness
Measurable	+	
Consistent	+	
Precise	+	
Sensitive	+	
Simple	+	

Example:

[to be inserted]

Useful References and Other Information:

Rodney V. Salm and John R. Clark, 2000. Marine and Coastal Protected Areas: A Guide for Planners and Managers (3rd Edition). International Union for Conservation of Nature and Natural Resources, Gland, Switzerland. Chapter 2. Site Planning and Management.

Hockings, M. S. Stolton, N. Dudley and J. Parrish. 2002. The Enhancing Our Heritage Toolkit, Book 2. pp. 24-30. Publication available from www.enhancingheritage.net

Governance Indicator 2: Understanding of MPA rules and regulations by the community

What is 'understanding of MPA rules and regulations by the community'?

Understanding of MPA rules and regulations by the community is a measure of whether stakeholders are aware of the rules and regulations and whether they understand the intent of the rules and regulations.

Why should this indicator be measured?

MPA rules and regulations define specifically what acts are required, permitted and forbidden by stakeholders and government agencies by the MPA. When stakeholders are aware of and have an understanding of the rules and regulations for management of the MPA, there is a greater chance for success of the MPA. . Stakeholders may violate rules and regulations if they are not well understood or if they don't make sense to the stakeholders.

What is required to measure the indicator?

- copy of the MPA management plan
- copy of MPA rules and regulations
- questionnaire to be used to interview key informants
- data on rules and regulations violations
- one interviewer
- paper/pencil

How are data collected on the indicator?

A sample of the stakeholders will be interviewed using a questionnaire to determine their awareness of and understanding of the MPA rules and regulations. In the case of a comprehensive plan for a large area, there may be a large number of rules and regulations with slight temporal or spatial variations. These variations should be considered in questionnaire design.

First, list and briefly describe the relevant MPA rules and regulations and the institution(s) which declare each rule and regulation.

Next, ask a series of questions to determine awareness and understanding. Record any discussion that illustrates their thoughts.

1. Are you aware of the existence of any rules and regulations for the management of the MPA? Yes____ No_____
2. What are these rules and regulations? Please list as many as you know.
3. Which institution(s) have declared and developed each rule and regulation.
4. For each informant, ask whether they regard the rules and regulations as being simple and clear:
   1 = rules and regulations are very complex and difficult to understand
   2 = rules are complex and difficult to understand
   3 = rules are of average complexity
   4 = rules are simple and easy to understand
   5 = rules are very simple and easy to understand
5. Do you feel that the rules and regulations design process was participatory?
6. Do you feel "ownership' of the rules and regulations?
7. Do you feel that the rules and regulations are credible and appropriate?
8. Do you feel that the rules and regulations are socially acceptable to the stakeholders?
9. Which rules and regulations do you feel are acceptable or unacceptable?
10. Why?
11. Why were the rules and regulations designed the way they are?

These data can be collected at the start of the project and every year thereafter.

How are results interpreted and shared?

Tabulate the responses from all the questionnaires. Use simple statistical analysis (median, mode, standard deviation) on the data. Analyze the percentage of the MPA rules and regulations that individuals can name to measure understanding and awareness. Present in narrative format with tables. Record any interesting discussion about awareness and understanding of the rules and regulations that may be useful for supporting or revising the rules and regulations. The responses should be cross-checked against the rules and regulations in the plan

Outputs

- narrative description of the rules and regulations as understood by the stakeholders.

Strengths and Limitations of this indicator

A limitation of the indicator is that it does not measure level of participation of stakeholders in creating the rules and regulations and their perception of fairness of the rules and regulations. It should be noted that in some cases people who do not like the rules can pretend that they do not know about them or can provide other misleading responses making it difficult to obtain correct information.

	Strength	Weakness
Measurable	+	

Consistent	+	
Precise		-
Sensitive	+	
Simple	+	

Example:

[to be inserted]

Useful References and Other Information:

Eleanor Ostrom. 1990. Governing the Commons: The Evolution of Institutions for Collective Action. Cambridge University Press, Cambridge, United Kingdom.

Governance Indicator 3: Existence of an MPA decision-making and management body

What is 'existence of an MPA decision-making and management body'?

Existence of an MPA decision-making and management body is a measure of the recognition of an institution that governs how the MPA is managed and used and a transparent process for management planning, establishing rules and regulations, and enforcing the rules and regulations.

Why should this indicator be measured?

The existence of a legally mandated MPA decision-making and management body will lead to more professional management of the MPA, that management will be more effective and accountable, and that it will become easier to have a successful MPA. It should be noted that in some cases the management body (the group implementing the MPA management plan) may or may not be the same as the decision-making body and that this has implications for the likely effectiveness of the MPA (more effective when both bodies are the same).

What is required to measure the indicator?

- MPA management plan.
- Papers of incorporation of an MPA decision-making and management body.
- Location of MPA decision-making and management body.
- Identification of MPA staff.
- Dates and location of meeting of body
- One interviewer
- Paper/pencil

How are data collected on the indicator?

First, identify institution(s) that have some level of decision-making and management authority and responsibility for the MPA (international, national, regional, municipal). This information is typically identified in the MPA management plan. A typical MPA management plan will have an organization chart showing the lines of authority and responsibility for MPA management. If such an organization chart does not exist, one can be developed through interviews with MPA staff. Identify the distance (both geographically and administrative) of decision-making and management body from the MPA. Identify the hierarchies of bodies and the relationship between them.

Second, confirm the existence of each body by identifying a person responsible for the body's operation. Interview the person to collect any documents explaining the function and powers of the body.

Third, record the legal and formal or informal authority of the body from papers of incorporation, plan or other documents.

Fourth, Identify the frequency of meetings to determine how functionality of the decision-making body. Observe the operation of the body at a meeting to determine how it operates, the process of decision-making, and roles and responsibility of actors of the body.

Optionally, key informants (resource users) in the community can be interviewed to identify and describe the body's he or she believes has decision-making and management authority and responsibility for the MPA.

How are results interpreted and shared?

An organization chart for the MPA can be developed listing all bodies with decision-making and management authority and responsibility. A narrative description of the authority and responsibility of each body and the mandate (formal/non-formal, legal) of the body is prepared.

Outputs

- list and narrative description of the different MPA decision-making and management body's including a description of their mandate to make management decisions.

Strengths and Limitations of the indicator

While this indicator will list and describe each decision-making and management body associated with the MPA, it will not evaluate the effectiveness, credibility and accountability of the body. A more complete survey will need to be undertaken to collect this information.

	Strength	Weakness
Measurable	+	
Consistent	+	
Precise		-
Sensitive		-
Simple	+	

Example:

[to be inserted]

Useful References and Other Information:

Fikret Berkes, Robin Mahon, Patrick McConney, Richard Pollnac and Robert Pomeroy. 2001. Managing Small-Scale Fisheries: Alternative Directions and Methods. International Development Research Center, Ottawa, Canada. Available for downloading at: www.idrc.ca/booktique

Governance Indicator 4: Existence and adequacy of legislation to enable the MPA to accomplish its goals and objectives

What is 'existence and adequacy of legislation'?

Existence and adequacy of legislation to enable the MPA to accomplish its goals and objectives is a measure of formal legislation in place to provide the MPA with a sound legal foundation so that the goals and objectives of the MPA can be recognized, explained, respected, accomplished and enforced. In some areas, traditional law may also serve as a foundation for the MPA.

Why should this indicator be measured?

The establishment of an MPA more often than not requires the drafting and adoption of appropriate supportive legislation and in some cases the recognition of traditional laws. The purpose of this indicator is to ensure that the MPA management plan is supported by adequate legislation in order for its successful implementation.

What is required to measure the indicator?

- Legal documents of pertinent laws at different levels (international, national, state/provincial, local) for MPAs
- MPA management plan.
- One interviewer
- Paper/pencil

How are data collected on the indicator?

The form and extent of legislation for MPAs will vary widely by country. The legal arrangements for MPAs may depend upon many elements, including the form of government, available finances, public administrative structures, level of government centralization/decentralization, lines of jurisdiction and decision-making, existence and legitimacy of traditional laws, and commonly accepted practice.

The first step is to collect all legal documents of pertinent laws relative to the MPA. These may exist at international, national, state/provincial and local levels. The laws may be identified in the MPA management plan. This will require talking to the MPA manager and reviewing the management plan and supporting documents. It may also require contacting various government agencies and offices to collect the documents. It should be noted that in addition to legislation related to the MPA, the achievement of the MPA goals and objectives may require that activities be undertaken outside of the MPA, such as water quality and integrated coastal zone management. Legislation related to these other associated activities should also be identified.

Second, a legal diagnosis is conducted. It will involve three steps. First, is to determine the existence of legislation to support the MPA. Second, is to compare the MPA management plan (the goals and objectives, rules and regulations, management authority and responsibility, enforcement powers) with the existing legislation to determine compatibility. Third, is to assess the appropriateness of the legislation.

To undertake the legal analysis, the following questions to be asked include:

1. What laws (formal and traditional) are in place? (e.g. fisheries , tourism, water quality, integrated coastal zone management, forest)
2. What institutions are in place to implement the laws? (governmental, non-governmental, traditional)
3. How current are the laws? (when were they approved (year))
4. What is the form and extent of the legislation?
5. Is the law at the appropriate level (local, state/province, national) to support the MPA?
6. Does the legislation support the goals and objectives of the MPA?
7. Are there sufficient laws to support the MPA?
8. Are the laws appropriate to support the MPA?
9. Are there legal provisions of sufficient penalties for violators of MPA rules and regulations.

How are results interpreted and shared?

A narrative is prepared focusing on answering the following three questions:

- Does a law exist to support the MPA? Yes/no
- Is it compatible with the MPA management plan? A little/mostly/very much
- Is it supportive of the MPA management activities and interventions? A little/mostly/very much

Outputs

- A report on the existence of laws for MPAs, the compatibility of the laws for MPAs, and recommendations (needs and types of legislation) for the MPA.

Strengths and Limitations of this indicator

A subjective analysis can be biased by the opinion of the person doing the legal diagnosis. There is a need for a good understanding of the management goals and objectives and the legislative process.

	Strength	Weakness
Measurable	+	

Consistent	+	
Precise	+	
Sensitive	+	
Simple	+	

Example:

[to be inserted]

Useful References and Other Information:

Rodney V. Salm and John R. Clark, 2000. Marine and Coastal Protected Areas: A Guide for Planners and Managers (3rd Edition). International Union for Conservation of Nature and Natural Resources, Gland, Switzerland. Chapter 6. Institutional and Legal Framework.

Governance Indicator 5: Degree of stakeholder participation in management of the MPA

What is 'degree of stakeholder participation'?

The degree of stakeholder participation in the management of the MPA is a measure of the amount of active involvement of people in making MPA management decisions or involvement in management activities.

Why should this indicator be measured?

MPA managers have come to realize that the active participation of coastal resource stakeholders in the planning and management of an MPA can improve success of the MPA. If local people are involved in the MPA and feel ownership over it, they are more likely to support the MPA. Stakeholders are important because they can support and sustain an MPA. They can be potential partners or threats in managing the MPA.

What is required to measure the indicator?

- Identification of stakeholders
- Key informants
- Identification of formal and informal co-management arrangements in the MPA management plan.
- Identification of actual stakeholder participation in decision-making and management activities (when, how and how much).
- One interviewer/facilitator
- Paper/pencil

How are data collected on the indicator?

Stakeholders are individuals, groups, or organizations of people who are interested, involved or affected (positively and negatively) by the MPA. They are motivated to take action on the basis of their interests or values. These stakeholders may or may not actually live within or adjacent to the site, but are people who have an in interest in or influence on the MPA.

The process of identifying stakeholders and figuring out their respective importance regarding decisions on the MPA is called stakeholder analysis. A stakeholder analysis is an approach and procedure for gaining an understanding of a system by means of identifying the key actors or stakeholders in the system, and assessing their respective interests in that system. This method provides insights about the characteristics of individuals and/or groups and their respective relationship to the MPA. It also examines the stakeholders' interests in the MPA and the impact of the activity on the stakeholder. Such an analysis is usually conducted in a participatory way.

The stakeholders are first identified by looking at activities affecting the MPA either directly or indirectly. Primary and secondary stakeholders are identified for each activity. The fisher community or organization is considered a primary stakeholder of coastal resources. Some stakeholders may fall into several categories and should be identified separately. Other stakeholders include government agencies, private/business organizations, non-academic organizations, academic or research institutions, religious/cultural groups and donors. The different stakeholder groups may be listed in a table with information on name, activity, members, leaders/representatives, purpose, and degree of activity (very, average, little). Stakeholder groups can be divided into smaller and smaller sub-groups depending on the particular purpose for stakeholder analysis. Ultimately, every individual is a stakeholder, but that level of detail is rarely required.

An approach to conducting a stakeholder analysis is:

1. Identify the main purpose of activity to be analyzed
2. Develop an understanding of the MPA and decision-makers in the MPA
3. Identify and list stakeholders. Write their names on paper circles. Use larger circles for stakeholders with greater influence or power.
4. Prepare a stakeholder analysis matrix:

Proposed action: MPA	Positively affected (+)	Negatively affected (-)
Directly affected		
Indirectly affected		

5. Place stakeholder identification circles from 3 on the appropriate box of the stakeholder analysis matrix.
6. Draw lines between the stakeholders to indicate the existence of some form of interaction or relationship.
7. Identify stakeholder interests, characteristics and circumstances.
8. Write the information from 7 for each stakeholder group
9. Discuss strategies or courses of action for addressing various stakeholder interests.

Once the stakeholders are identified, their degree of participation can be determined using one of two methods:

1. Observation of their participation in meetings of the MPA to see if the stakeholders and their representatives attend the meetings, express their opinion and if their opinion is considered.

2. A survey is conducted to determine degree of participation. Respondents are asked about their level of participation. For example, respondents are shown a line with 10 marks on it, the first line indicating no participation and the tenth line indicating full and active participation. The respondent is asked to identify on the line their degree of participation in MPA management. The results are summed up by stakeholder

group and by the total stakeholders. This method can be used over time to evaluate changes in participation. In addition, useful discussion about their participation in MPA management is recorded.

How are results interpreted and shared?

The stakeholder analysis provides a stakeholder analysis matrix and a participation matrix. The results will provide us with a quantitative measure of the degree of stakeholder participation in MPA management which can be used to monitor and evaluate community involvement and to provide input into making necessary changes in the co-management arrangements. It should be noted that more participation is not necessarily better, so participation needs to be linked to the MPA plan which may specify low levels of participation.

Outputs

- Stakeholder analysis matrix
- Stakeholder participation matrix
- An overall score of the degree of stakeholder participation in MPA management which can be measured over time to assess changes.

Strengths and Limitations of this indicator

It is often not easy to identify stakeholders and some may be missed, especially those who are poor, unorganized and powerless. Provides insights into the dynamics and relationships of different stakeholders with the MPA.

	Strength	Weakness
Measurable	+	
Consistent	+	
Precise	+	
Sensitive		-
Simple	+	

Example:

[to be inserted]

Useful References and Other Information

S. Langill (compiler) 1999. Stakeholder Analysis. Volume 7. Supplement for Conflict and Collaboration Resource Book. International Development Research Center, Ottawa, Canada.

Governance Indicator 6: Level of satisfaction of stakeholders with participation

What is 'level of satisfaction of stakeholders with participation'?

Level of satisfaction of stakeholders with participation is a measures of stakeholder's satisfaction with their level of participation in MPA management and if they consider that their views and concerns are being heard and considered.

Why should this indicator be measured?

MPA managers have come to realize that the active participation of coastal resource stakeholders in the planning and management of an MPA can improve success of the MPA. If stakeholders are satisfied that they are being allowed to participate in MPA management and that their views and concerns are being heard and considered, they are more likely to support the MPA. If they are not satisfied, than they are more likely not to support the MPA.

What is required to measure the indicator?

- Identification of stakeholders using stakeholder analysis.
- Questionnaire to identify stakeholder satisfaction with the level of participation in MPA management.
- One interviewer
- Paper/pencil

How are data collected on the indicator?

It is assumed that the stakeholders in MPA management have been identified.

A survey is conducted to determine the stakeholder's level of satisfaction with participation in MPA management. Respondents are asked about their level of satisfaction with participation. For example, respondents are shown a line with five marks on it. The first line indicates dissatisfaction with the level of participation and the fifth line indicates full satisfaction with the level of participation. The respondent is asked to identify on the line their level of satisfaction with participation in MPA management. This method can be used over time to evaluate changes in level of satisfaction with participation. In addition, useful discussion about participation is recorded.

Due to similarities in data collection, the data for indicators 5 and 6 can be collected simultaneously.

In addition, the participation of stakeholders in meetings of the MPA can be observed to see if the stakeholders and their representatives attend the meetings, actively participate through expressing their opinion, and if their opinion is considered. Informal discussions can be help with individual stakeholders to assess their level of satisfaction with participation. Notes can be taken to record comments.

How are results interpreted and shared?

The results of the survey are summed up by stakeholder group and by the total stakeholders and presented in a table. An overall score of the level of satisfaction of stakeholders with participation in MPA management can be calculated and measured over time to assess changes. A narrative is written which reports the results and which includes comments from the respondents and observations from the interviewer.

The results will provide us with a quantitative measure of the level of satisfaction of stakeholders with their participation in MPA management which can be used to monitor and evaluate community involvement and to provide input into making necessary changes in the co-management arrangements.

Outputs

- Table of overall score of the level of satisfaction of stakeholders with participation in MPA management
- Narrative which reports the results of satisfaction score and which includes comments from the respondents and observations from the interviewer.

Strengths and Limitations of this indicator

It should also be noted that some stakeholders have unrealistic and unreasonable expectations of participation, and hence, low levels of satisfaction.

	Strength	Weakness
Measurable	+	
Consistent	+	
Precise		-
Sensitive	+	
Simple	+	

Example:

[to be inserted]

Useful References and Other Information:

S. Langill (compiler) 1999. Stakeholder Analysis. Volume 7. Supplement for Conflict and Collaboration Resource Book. International Development Research Center, Ottawa, Canada.

Governance Indicator 7: The amount and quality of training provided to resource users to participate in MPA management

What is 'training provided to resource users to participate'?

The amount and quality of training provided to resource users to participate in MPA management is a measure of the amount and effectiveness of capacity building efforts to empower resource users (e.g. fisher, dive operator) with knowledge, skills and attitudes to participate in MPA management.

Why should this indicator be measured?

To participate effectively in MPA management, resource users need to be empowered in order for them to have greater awareness about the needs for and functions of the MPA. Resource users need to be equipped with knowledge, skills and attitudes to prepare them to carry out new tasks and meet future challenges. Capacity building must address not only technical and managerial dimensions but also attitudes and behavioral patterns. Capacity building may be carried out by the MPA staff or by another organization, such as a non-governmental organization (NGO).

What is required to measure the indicator?

- Copy of MPA capacity building program.
- Access to workshop and training records provided to stakeholder by the MPA management or other organization.
- Interview of stakeholders to assess satisfaction with capacity building activities.
- Interview of MPA management or other organization to assess level of attendance of stakeholders at capacity building activities.
- One interviewer
- Paper/pencil

How are data collected on the indicator?

First, identify if there is a training program in place and operational for resource users. This information should be available from MPA staff. Obtain any documents describing the training program.

Second, record the number and types of workshops and trainings courses provided to the resource users during planning and implementation of the MPA. This information should be available from the MPA management office or other organization providing capacity building.

Third, interview MPA management staff or other organization providing training and ask questions concerning capacity building activities including:

1. How large is the capacity building budget compared to overall MPA budget?
2. Were capacity building activities provided during planning for the MPA to empower resource users to actively participate in the planning?
3. Were capacity building activities undertaken during implementation and are they still provided?
4. Who makes decisions about the number and types of capacity building activities – MPA management, resource users, both?
5. What are the skills of the staff to provide the training and do they need more training?
6. Is the capacity building budget sufficient to carry out the activities?
7. Are there evaluation reports from the workshops/trainings or follow-up reports.

Fourth, interview the resource users to determine their satisfaction with capacity building activities and the quality of the activities. A short questionnaire is prepared to include questions such as:

1. Were workshops and trainings courses provided to you during the planning of the MPA?
2. How many and what types were provided?
3. Were workshops and training courses provided to you during implementation of the MPA?
4. How many and what types were provided?
5. Were you satisfied with the workshops and training courses? Yes/no
6. Why?
7. Were you involved in the selection of the workshops and training courses?
8. Have the workshops and training courses affected your support for the MPA? Yes/no
9. Why?
10. Were you satisfied with the training skills of the staff?
11. Make a list of all the workshops and trainings and ask participants to rate their satisfaction on a scale of one (poor) to five (excellent).

Many workshops and trainings conduct evaluations after the activity to assess the effectiveness of the program. These evaluations may be available from the trainers and can be reviewed to determine participant's level of satisfaction and knowledge gained from the activity.

As a follow-up activity to the workshops and trainings, observe the resource users participation in MPA management meetings over time to determine if there are observable changes in participation and input as a result of the capacity building activities. It will be possible through careful listening and observation, and using records of meetings, to determine if new ideas presented through the capacity building activities are being presented and discussed at the meetings. For this data collection method to work, observations would be required prior to capacity building activities and afterward.

Informal discussions with individual resource users can help to assess their level of satisfaction with their ability to participate in MPA management as a result of their participation in the workshops and trainings. Notes can be taken to record comments.

Data for this indicator could be collected with indicator 8.

How are results interpreted and shared?

A narrative report is prepared from the results which provides an evaluation of the achievements of capacity building activities and makes recommendations for future activities.

Empowerment of resource users to participate in MPA management is important for its success. Information is provided for further capacity building activities and evaluating how well past activities have done in terms of knowledge, skills and attitude development.

Outputs

- narrative report on the achievements of capacity building activities

Strengths and Limitations of this indicator

	Strength	Weakness
Measurable	+	
Consistent	+	
Precise		-
Sensitive	+	
Simple		-

Example:

[to be inserted]

Useful References and Other Information:

Governance Indicator 8: The amount and quality of training provided to community organization to participate in MPA management

What is 'training provided to community organization to participate'?

The amount and quality of training provided to community organization to participate in MPA management measures the amount and effectiveness of capacity building to establish and enable community organizations (e.g. fisher association, fisher cooperative, dive operator association, home owners association) to participate in MPA management.

Why should this indicator be measured?

The existence of a legitimate community organization is a vital means for representing resource users and stakeholders to be represented in and to influence the direction of MPA decision-making and management. Training must address not only establishing and enabling community organizations, but also empowering the organizations to actively participate in MPA management. The indicator can provide important and timely information for determining the effectiveness of capacity building and future needs.

What is required to measure the indicator?

- List of community organizations and their staff associated with the MPA.
- Copy of MPA capacity building program.
- Access to workshop and training records provided to community organization by the MPA management or other organization providing training.
- Interview of community organization members to assess satisfaction with capacity building activities.
- Interview with training staff.
- One interviewer
- Paper/pencil

How are data collected on the indicator?

First, identify if there is a training program in place and operational for community organizations. This information should be available from MPA staff. Obtain any documents describing the training program.

Second, record the number and types of workshops and trainings courses provided to the community organizations during planning and implementation of the MPA. This information should be available from the MPA management office or other organization providing capacity building.

Third, interview MPA management staff or other organization providing training and ask questions concerning capacity building activities including:

1. How large is the capacity building budget compared to overall MPA budget?
2. Were capacity building activities provided during planning for the MPA to establish community organizations?
3. Were capacity building activities undertaken during implementation and are they still provided?
4. Who makes decisions about the number and types of capacity building activities – MPA management, community members, both?
5. What is the management structure of the community organization?
6. What are the skills of the staff to provide the training and do they need more training?

Fourth, interview members and leaders of the community organization to determine their satisfaction with capacity building activities and the quality of the activities. A short questionnaire is prepared to include questions such as:

1. Were workshops and trainings courses provided to you during the planning of the MPA?
2. How many and what types were provided?
3. Were workshops and training courses provided to you during implementation of the MPA?
4. How many and what types were provided?
5. Were you satisfied with the workshops and training courses? Yes/no
6. Why?
7. Were you involved in the selection of the workshops and training courses?
8. Have the workshops and training courses affected your support for the MPA? Yes/no
9. Why?
10. Was the capacity building program important for the establishment of the community association?
11. Were you satisfied with the training skills of the staff?

Many workshops and trainings conduct evaluations after the activity to assess the effectiveness of the program. These evaluations may be available from the trainers and can be reviewed to determine participant's level of satisfaction and knowledge gained from the activity.

As a follow-up activity to the workshops and trainings, observe the community organization's leaders and member's participation in MPA management meetings over time to determine if there are observable changes in participation and input as a result of the capacity building activities. It will be possible through careful listening and observation, and using records of meetings, to determine if new ideas presented through the capacity building activities are being presented and discussed at the meetings. For this data collection method to work, observations would be required prior to capacity building activities and afterward. Informal discussions with community organization's leaders and members can help to assess their level of satisfaction with their ability to participate in MPA management as a result of their participation in the workshops and trainings. Notes can be taken to record comments.

Data for this indicator could be collected with indicator 7.

How are results interpreted and shared?

A narrative report is prepared from the results which provides an evaluation of the achievements of capacity building activities and makes recommendations for future activities.

The capacity building needs of community organizations will vary greatly by location from establishment of new organizations to strengthening of existing organizations to engage in MPA management. It will be useful to have available a formal capacity building program in written form from the MPA management in order to analyze if capacity building targets have been met.

Information is provided for further capacity building activities and evaluating how well past activities have done in terms of establishing and strengthening community organizations and in enhancing knowledge, skills and attitude development.

Outputs

- narrative report on the achievements of capacity building activities

Strengths and Limitations of this indicator

	Strength	Weakness
Measurable	+	
Consistent	+	
Precise		-
Sensitive	+	
Simple		-

Example:

[to be inserted]

Useful References and Other Information:

Governance Indicator 9: Community organization formed and active

What is 'community organization formed and active'?

Community organization formed and active measures whether a community organization exists, whether it is effectively organized to participate in management, and how active it is in MPA decision-making and management.

Why should this indicator be measured?

A community organization is a vital means for representing resource users and stakeholders and influencing the direction of MPA decision-making and management. The indicator provides useful information on community organizations associated with the MPA management. An understanding of these organizations can assist the MPA management in improving participation and representation of stakeholders in management and decision-making.

What is required to measure the indicator?

- List of community organizations
- List of community organizations associated with the MPA
- Minutes of previous meetings
- One interviewer
- Paper/pencil

How are data collected on the indicator?

First, a list of community organization associated with the MPA will need to be developed. A list may be available from the MPA management office. If no such list exists, the community associations will need to be identified. This can be done through interviews of key informants. Key informants include, but are not limited to, government officials, community leaders, members of other associations in the community, senior fishers, religious organizations, and non-governmental organizations.

Second, for each organization, the following information is collected:

- Objectives/mission statement
- Functions/responsibilities
- Period of existence
- Number of different management bodies in which the organization participates

In addition, the following additional information may be collected on the organization:

- Spatial jurisdiction
- Legal authority
- Formal/informal administration
- Organizational chart
- Leadership structure
- Membership (number, requirements)
- Staff (number, expertise)
- Budget
- Meeting schedule
- Rules of operation
- Relationships/affiliations with other organizations

Third, to determine how active the organization is, it is useful to attend at least one of their meetings, and more if possible. At these meetings, observe:

1. How many people attend the meeting,
2. The issues and level of discussion,
3. The procedures followed, and
4. The decisions and consensus reached
5. Whether rules of order are observed at the meeting
6. Whether everyone is given a chance to talk
7. Whether the meeting environment is organized or disorganized

Fourth, ask the leaders and members about their satisfaction with their ability to participate in management.

If possible, have an informal discussion with the leaders and members to determine their feelings about the organization, how well it operates, and how well it represents their interests.

Finally, at meetings of the MPA, observe how many of the community organizations regularly participate in the meetings and how active they are in terms of providing input and discussion at the meeting. It is possible to evaluate how active the community organization is in the MPA management meetings by observing if:

1. The input from the community organization represents the interests of one or two people or the whole group
2. Only representatives of the community organization attend the meetings or do members as well
3. The input provided by the community organization is relevant to the current issues being discussed

How are results interpreted and shared?

A narrative report is prepared which lists the organization(s), mandate, organizational structure, period of existence, membership, resources, and relationship/affiliation with other organizations. The report should identify, for example, those organizations opposed and supportive of the MPA. The report should also include observations on the level of activity of each organization.

The indicator will provide information on the number of community organizations associated with the MPA, the objectives and structure of each organization, and how active the group is in terms of providing input to the MPA and in terms of other activities for its members. The results need to be interpreted against the background of the level of community or collective action in the country or location, which may be low in some cases.

Outputs

- a narrative report which identifies community organizations involved in MPA management and describes their characteristics and level of active involvement in MPA management.

Strengths and Limitations of this indicator

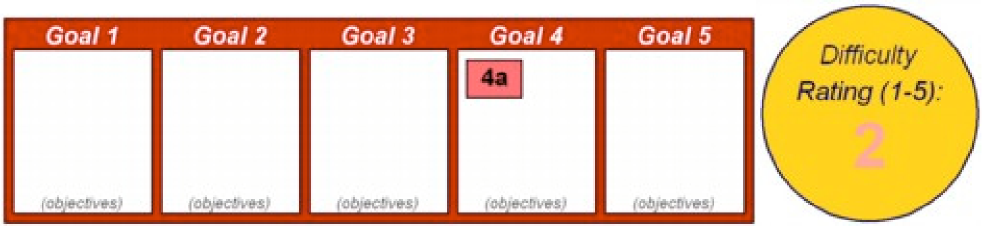
	Strength	Weakness
Measurable	+	
Consistent	+	
Precise	+	
Sensitive	+	
Simple	+	

Example:

[to be inserted]

Useful References and Other Information:

Governance Indicator 10: Available human resources and equipment for surveillance and monitoring



What is 'available human resources and equipment for surveillance and monitoring'?

Available human resources and equipment for surveillance and monitoring is a measure of the number of trained people available for surveillance and monitoring purposes and the equipment available to undertake these functions.

Why should this indicator be measured?

Surveillance and monitoring are critical parts of any MPA enforcement program. The rationale is that some degree of illegal activities (for example, fishing, boating, pollution) can be anticipated as a response to a regulatory framework established for the MPA. An understanding of the availability of adequate human resources and equipment to undertake surveillance and monitoring is important because these are the people and associated equipment which will undertake this activity. It is assumed that the more human resources and equipment available for this activity, the greater will be the level of compliance with rules and regulations.

What is required to measure the indicator?

- Copy of the MPA management plan.
- List of MPA staff and associates involved in surveillance and monitoring.
- List of equipment available for surveillance and monitoring.
- List of minimum requirements or of ideal requirements to have effective surveillance and monitoring from the management plan.
- One interviewer
- Paper/pencil

How are data collected on the indicator?

First, identify the MPA monitoring, control, surveillance and enforcement program. The management plan should include a section which describes the monitoring, control, surveillance and enforcement program for the MPA. This will provide information on program design for comparison with the current structure. The management plan should also provide information on the minimum requirements or of ideal requirements for an effective monitoring, control, surveillance and enforcement program. This can be used to compare with the existing resources available for these tasks. If no such information exists, an interview is conducted with the MPA manager to determine minimum requirements or of ideal requirements for an effective monitoring, control, surveillance and enforcement program.

Second, an interview is conducted with the MPA manager and the designated enforcement staff member to obtain information about the current monitoring, control, and surveillance and enforcement structure. The focus of the questions asked is:

1) The adequacy of resources to undertake the task, and
2) The appropriateness of surveillance and monitoring operation to undertake the task.

It should be noted that some MPAs leave this activity to national agencies, such as Coast Guard or marine police. In this situation, the questions will need to be adapted to reflect this arrangement.

Questions to be asked of the MPA manager and the designated enforcement staff member include:

1. What is the number of MPA staff assigned to the program?
2. What is the number of non-MPA staff (community members, fishers) assigned to the program?
3. What kind/level of training is provided to management and staff?
4. What is the experience (type and years) and education (level) of each staff member?
5. What is the budget level for enforcement?
6. What equipment are available (boat, guard house, radio, GPS, binoculars, uniform, dive equipment, computers) for enforcement?
7. What is the age and condition of equipment used?
8. What is the level of vessel maintenance?
9. What record keeping procedures are used?

Enforcement staff may be asked about the management arrangements (plans, senior staff, information feedback) to undertake the task.

How are results interpreted and shared?

A narrative report is prepared on the current staffing and equipment for undertaking the surveillance and monitoring program. The report should address allocated resources as compared to needed resources and recommendations for resources to undertake program. Feedback from the staff on the appropriateness of the resources, equipment and management to undertake the task is recorded and written in a report.

The number of staff will give a measure of the importance given to this program and is useful when planning the number and frequency of patrols. The staff should have an adequate supply of resources and good quality condition equipment to undertake their assignment.

Outputs

- report on the current staffing and equipment for undertaking surveillance and monitoring program

Strengths and Limitations of this indicator

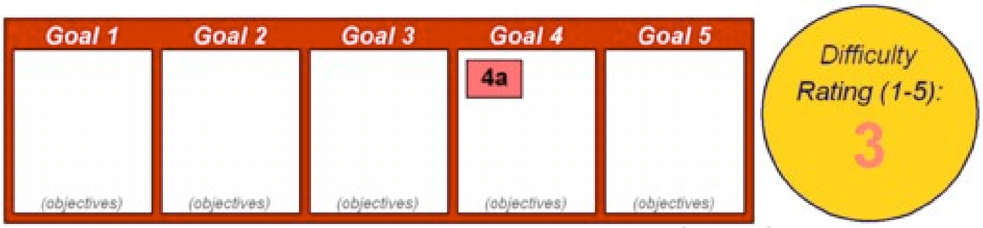
	Strength	Weakness
Measurable	+	
Consistent	+	
Precise	+	
Sensitive	+	
Simple	+	

Example:

[to be inserted]

Useful References and Other Information:

Governance Indicator 11: Clearly defined enforcement procedures



What is 'clearly defined enforcement procedures'?

Clearly defined enforcement procedures is a measure of the existence and description of guidelines and procedures developed for staff charged with enforcement responsibilities and how they are to act depending on the type of offence encountered.

Why should this indicator be measured?

Enforcement is a crucial step in the MPA management system. Clearly defined enforcement procedures allow MPA enforcement staff to more effectively undertake their duties and for resource users to be aware of consequences of non-compliance.

What is required to measure the indicator?

- Copy of the MPA monitoring, control, surveillance and enforcement section from the management plan.
- Copy of the enforcement guidelines.
- one interviewer
- paper/pencil

How are data collected on the indicator?

First, in the management plan the section which describes the monitoring, control, surveillance and enforcement program for the MPA is identified. This will provide information on the enforcement program and its structure. If no section on enforcement procedures exists, an interview is conducted with the MPA manager and the enforcement staff to identify the monitoring, control, surveillance and enforcement program.

Second, an interview is conducted with the MPA manager and the designated enforcement staff member to obtain information about the enforcement guidelines. Questions to be asked include:

1. Do formal enforcement guidelines and procedures exist?
2. Do informal enforcement guidelines and procedures exist?
3. Who prepared these guidelines and procedures?
4. Description of the guidelines and procedures.
5. Are they periodically reviewed and updated?

6. Are staff trained in the guidelines and procedures?
7. Is there coordination of the guidelines and procedures with other enforcement agencies?
8. Are the enforcement guidelines and procedures appropriate to the task?
9. Number of reported violations.
10. Number of successful prosecutions due to clearly defined enforcement procedures.
11. Number of attempted prosecutions that failed due to technicalities due to failure in procedure.
12. Accessibility and availability of enforcement guidelines.

How are results interpreted and shared?

A narrative report on the current enforcement guidelines and procedures, adequacy and availability of the guidelines, procedures to undertake enforcement actions, and recommendations for improvements.

Clearly defined enforcement guidelines and procedures will improve monitoring, surveillance and enforcement of the MPA thus benefiting the MPA management, will allow enforcement staff to act professionally, and will reduce the possibility of legal action against the MPA management by rule breakers. This measure will allow for a review of enforcement guidelines and procedures to ensure that they are implemented in a fair and equitable manner.

Outputs

- narrative report on the current MPA enforcement guidelines and procedures

Strengths and Limitations of this indicator

	Strength	Weakness
Measurable	+	
Consistent	+	
Precise		-
Sensitive	+	
Simple	+	

Example:

[to be inserted]

Useful References and Other Information:

Governance Indicator 12: Number and variety of patrols per time period per unit area

What is 'number and variety of patrols per time period per unit area'?

The number and variety of patrols per time period per unit area is a measure of the number of surveillance and monitoring patrols undertaken by MPA staff during a given time period and in a specified area.

Why should this indicator be measured?

This information is used to review the consistency of patrol activity. This information is a necessary prerequisite for assessing trends in violations or non-compliance since the latter is generally measured as the number of violations per patrol effort. It is also useful in determining how well the MPA management is meeting the goal of surveillance, monitoring and enforcement.

What is required to measure the indicator?

- Copy of patrol schedule and procedures
- Patrol records
- MPA quarterly/annual reports
- Map of area
- One interviewer
- Paper/pencil

How are data collected on the indicator?

First, the management plan and the enforcement program should have a section which describes the planned patrol schedule and procedures. This provides a base of information for comparison of actual patrols. If no such information exists, an interview is conducted with the MPA manager and staff involved in enforcement to describe the patrol schedule and procedures

Second, patrol records are reviewed to calculate the patrol effort in terms of:

1. Man-hours;
2. Total hours;
3. Number of patrols;

4. Variation in temporal and spatial patterns of patrols;
5. Patrol area (km^2); and
6. Number and type of infractions per patrol.

The above data can be disaggregated for different parts of the MPA and also different types of patrols (land, sea, MPA staff, community members). The actions undertaken during each patrol are reviewed to identify problems and needs to improve patrol activity. A map is prepared which shows patrol areas, number of patrols, and variation in temporal and spatial patterns of patrols.

Third, interviews are held with MPA staff to discuss patrol records and to learn about how patrols are undertaken and to identify problems and needs.

Fourth, interviews are conducted with resource users and stakeholders to learn about how patrols are undertaken, how the patrol officers act during a patrol, and problems and needs.

How are results interpreted and shared?

A narrative report is prepared which includes a discussion on the man-hours patrolling per month/year; hours patrolling per month/year; number of patrols/patrol days per month/year; and number of patrols per area and type and number and type of infractions. This information is mapped to show coverage of the MPA. In addition, the types of actions taken during each patrol are presented in a table and ranked, and mapped to identify trends, patterns and needs.

Improvements in patrol and patrol coverage can result from this indicator. In addition, improvements in overall enforcement of the MPA.

Outputs

- A narrative report
- A map showing distribution of patrols and types of activities occurring in and around the MPA

Strengths and Limitations of this indicator

The usefulness of the indicator will depend on the accuracy of the patrol records.

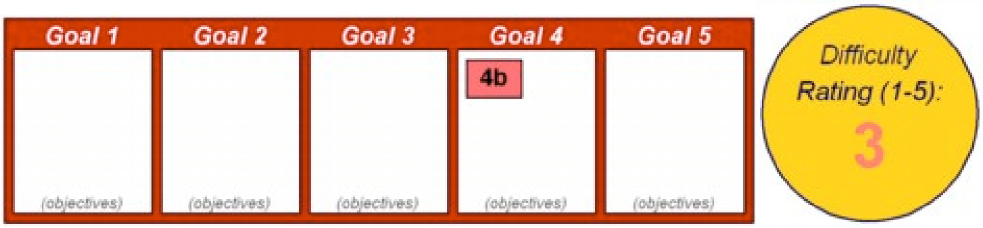
	Strength	Weakness
Measurable	+	
Consistent	+	
Precise		-
Sensitive	+	
Simple	+	

Example:

[to be inserted]

Useful References and Other Information:

Governance Indicator 13: Effective information dissemination to enhance and support compliance of stakeholders



What is 'effective information dissemination to enhance and support compliance of stakeholders'?

Effective information dissemination to enhance and support compliance of stakeholders is a measure of the number and effectiveness of capacity building efforts for stakeholders on objectives and benefits, rules, regulations and enforcement arrangements of the MPA.

Why should this indicator be measured?

Training and education will increase stakeholder knowledge about rules, regulations and enforcement arrangements for the MPA in order to change behavior and attitudes and increase compliance. Improvements in compliance with MPA rules and regulations by stakeholders should result from the training and education program.

What is required to measure the indicator?

- Copy of MPA capacity building program.
- Access to workshop and training records provided to stakeholders by the MPA management.
- Interview of stakeholders to assess satisfaction with capacity building activities (education, training).
- Enforcement records.
- Records and output of information dissemination (mailings, media, publications, web, signs, etc.)
- one interviewer
- paper/pencil

How are data collected on the indicator?

First, record the number and types of workshops and trainings courses and information dissemination provided to the stakeholders during planning and implementation of the MPA. This information should be available from the MPA management office.

Second, interview MPA management staff and ask questions concerning capacity building and information dissemination activities including:

1. How large is the capacity building and information dissemination budget compared to overall MPA budget?
2. Were capacity building activities provided during planning for the MPA on rules, regulations and enforcement arrangements?
3. Were capacity building activities undertaken during implementation and are they still provided?
4. Who makes decisions about the number and types of capacity building activities – MPA management, stakeholders, both?
5. What types of information dissemination efforts were undertaken?

Third, interview the stakeholders to determine their satisfaction with capacity building and information dissemination activities and the quality of the activities. Stakeholders differ and range from local fishers to foreign tourists. Several questionnaires may need to be developed for different stakeholder groups. A short questionnaire is prepared to include questions such as:

1. Were workshops and trainings courses provided to you during the planning of the MPA?
2. How many and what types were provided?
3. Were workshops and training courses provided to you during implementation of the MPA?
4. How many and what types were provided?
5. Were you satisfied with the workshops and training courses? Yes/no
6. Why?
7. Were you involved in the selection of the workshops and training courses?
8. What types of information dissemination were provided?
9. Which were most effective for you?
10. Why?
11. Have the workshops and training courses affected your compliance behavior? Yes/no
12. Why?
13. Do you have a better understanding of the rules, regulations and enforcement arrangements as a result of the workshops? Yes/no
14. Do you have a better understanding of the purpose of the MPA as a result of the workshops? Yes/no
15. Do you have a better understanding of coastal and marine ecosystems as a result of the information provided to you? Yes/no

Many workshops and trainings conduct evaluations after the activity to assess the effectiveness of the program. These evaluations may be available from the trainers and can be reviewed to determine participant's level of satisfaction and knowledge gained from the training.

Enforcement records kept by the MPA are reviewed to assess changes in the number of violations by stakeholders who have attended the training. Names of stakeholders who have attended the trainings should be available from participant list.

How are results interpreted and shared?

A narrative report describing the capacity building efforts for stakeholders to enhance and support compliance with MPA rules and regulations. A table showing correlation between capacity building and information dissemination program and enforcement compliance records is developed.

Effectiveness can be measured by comparing what activities have been undertaken with the different approaches to capacity building and information dissemination presented in the management plan. The indicator will measure linkages between training and education and information dissemination for stakeholders on objectives and benefits, rules, regulations and enforcement arrangements and overall improvements in compliance. If the stakeholders were not involved in the development of the rules and regulations, compliance has been shown to be lower than if they did participate.

Outputs

- A narrative report describing the capacity building efforts for stakeholders to enhance and support compliance with MPA rules and regulations.
- A table showing correlation between capacity building and information dissemination program and enforcement compliance records is developed.

Strengths and Limitations of this indicator

	Strength	Weakness
Measurable	+	
Consistent	+	
Precise		-
Sensitive	+	
Simple		-

Example:

[to be inserted]

Useful References and Other Information:

Governance Indicator 14: Regular meeting of MPA staff with stakeholders

What is 'regular meeting of MPA staff with stakeholders'?

Regular meeting of MPA staff with stakeholders is a measure of the number of regularly scheduled meetings between MPA staff and stakeholders to discuss compliance with MPA management plans.

Why should this indicator be measured?

Discussion, input and participation from stakeholders with MPA staff about compliance with MPA management plans will lead to greater compliance and increased success of the MPA.

What is required to measure the indicator?

- Records of regular meetings
- Interview MPA staff and stakeholders
- Meeting schedule between MPA staff and stakeholders
- One interviewer
- Paper/pencil

How are data collected on the indicator?

First, MPA staff are requested to provide records of regularly scheduled meetings between themselves and stakeholders. The number and location of meetings each year is recorded. Information is requested on the formal agenda, minutes of the meeting, topics of discussion, conflicts and solutions, and those in attendance. A review of these records will provide information on problems and issues related to compliance and enforcement.

Second, an interview is conducted with stakeholders involved in these meetings to determine topics of discussion, conflicts and solutions. The stakeholders are asked:

1. Are there regularly scheduled meetings with MPA staff to discuss issues of compliance?
2. Do you feel that your views are listened to and acted upon by MPA staff?
3. Are these meetings open and transparent to all stakeholders?

4. Are you allowed to participate in the making of rules and regulations?

How are results interpreted and shared?

A narrative report is prepared on the interviews and data collected. The report should include information from interviews with both MPA staff and stakeholders. It is important to identify any differences in information provided on number of meetings, discussion, and conflict and solutions. A tabulation can be made of the various topics discussed, resolutions made, and documentation of any consensus arrived at.

This indicator will provide useful information for improving surveillance, monitoring and enforcement arrangements through stakeholder input and participation; overall improvement in compliance behavior of stakeholders; and reduction in enforcement costs.

Outputs

- A narrative report describing meetings between MPA staff and stakeholders

Strengths and Limitations of this indicator

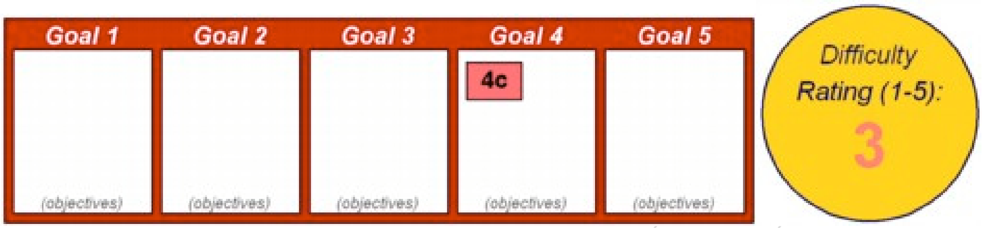
	Strength	Weakness
Measurable	+	
Consistent	+	
Precise		-
Sensitive	+	
Simple	+	

Example:

[to be inserted]

Useful References and Other Information:

Governance Indicator 15: Proportion of stakeholders trained in sustainable resource use



What is 'proportion of stakeholders trained in sustainable resource use'?

Proportion of stakeholders trained in sustainable resource use is a measure of the number of stakeholders who participated in training and with knowledge about sustainable resource use.

Why should this indicator be measured?

This indicator can be used to determine whether capacity-building efforts are resulting in a shift towards sustainable use of resources by stakeholders inside and outside the MPA. The linkage between training and education for stakeholders on sustainable resource use will be shown, as well as overall improvements in resource management and resource use. Information can be disaggregated for different types of training and broader awareness building. The results can be used to improve the effectiveness of the program.

What is required to measure the indicator?

- Reports of trainings and workshops
- Interviews with participants of trainings and workshops
- Interviews with volunteer groups and community organizations.
- One interviewer
- Paper/pencil

How are data collected on the indicator?

First, identify the total number of stakeholders and stakeholder organization associated with the MPA.

Second, from MPA staff obtain records on the number of stakeholders trained and the number and types of workshops and trainings and information dissemination on sustainable resource use provided to the stakeholders during planning and implementation of the MPA.

Third, interview MPA management staff and ask questions concerning capacity building activities including:

1. How large is the capacity building budget compared to overall MPA budget?
2. Were capacity building activities provided during planning for the MPA to train stakeholders to use resources sustainably?
3. Were capacity building activities undertaken during implementation and are they still provided?
4. Who makes decisions about the number and types of capacity building activities – MPA management, resource users, both?

Third, interview the stakeholders to determine their level of knowledge and satisfaction with capacity building activities and the quality of the activities. A short questionnaire is prepared to include questions such as:

1. Were workshops and trainings courses provided to you during the planning of the MPA?
2. How many and what types were provided?
3. Were workshops and training courses provided to you during implementation of the MPA?
4. How many and what types were provided?
5. Were you satisfied with the workshops and training courses? Yes/no
6. Why?
7. Were you involved in the selection of the workshops and training courses?
8. Have the workshops and training courses affected the way that you use resources? Yes/no Why?
9. What types of information dissemination were most useful?
10. What is sustainable resource use?
11. Do you follow sustainable resource use practices?
12. Have your resource use practices (for example, fishing, anchoring of boat) changed as a result of the trainings and workshops?
13. If yes, in what way?
14. If no, why not?

Many workshops and trainings conduct evaluations after the activity to assess the effectiveness of the program. These evaluations may be available from the trainers and can be reviewed to determine participant's level of satisfaction and knowledge gained from the activity and the skill level of the people trained.

How are results interpreted and shared?

A narrative report is prepared which provides an evaluation of the number of stakeholders who participated in training and with knowledge about sustainable resource use.

Outputs

- A narrative report

Strengths and Limitations of this indicator

	Strength	Weakness
Measurable	+	
Consistent	+	
Precise		-
Sensitive	+	
Simple		-

Example:

[to be inserted]

Useful References and Other Information:

Governance Indicator 16: Number of stakeholders involved in surveillance, monitoring and enforcement

What is 'number of stakeholders involved in surveillance, monitoring and enforcement'?

Number of stakeholders involved in surveillance, monitoring and enforcement is a measure of the number of stakeholders who have participated in patrolling or other monitoring activities.

Why should this indicator be measured?

Sharing surveillance, monitoring and enforcement activities with local stakeholders can be effective in controlling non-compliance behavior through social and peer pressure. Increased participation of stakeholders provides them with more ownership over the MPA which should result in an overall improvement in enforcement and a decrease in violations.

What is required to measure the indicator?

- Patrol records
- Interview stakeholders
- One interviewer
- Paper/pencil

How are data collected on the indicator?

Ideally all formal patrols are recorded on an ongoing basis so that this indicator should only require a synthesis of the existing patrol records. Patrol records are reviewed to determine who was involved in the patrols including:

1. Number of non-MPA staff
2. Amount of time of non-MPA staff involved in the patrol
3. Stakeholder group affiliation of non-MPA staff
4. Type and number of activities that non-MPA staff were engaged in

If patrols involving stakeholders are not recorded than this may require interviewing of key stakeholders within the community who are involved in patrolling. The number of non-MPA staff involved in patrols can be compared to some ideal number of non-MPA staff established in the management plan to determine management effectiveness.

Interview stakeholders to determine if they informally conduct surveillance and monitoring activities when then are in the area of the MPA. Question the stakeholder on:

1. How they conduct the activity (e.g., causal or formal observation).
2. How they report violations that they observe.
3. Who they report violations to.
4. What is done with reports of violations (is action taken?).

How are results interpreted and shared?

A narrative report is prepared which provides an evaluation of the number of stakeholders involved in surveillance, monitoring and enforcement.

Outputs

- A narrative report

Strengths and Limitations of this indicator

Only reports on formal involvement in surveillance, monitoring and enforcement. It is much more difficult to obtain information on informal involvement, such as when fishing or involved in tourism activity in the area.

	Strength	Weakness
Measurable	+	
Consistent	+	
Precise		-
Sensitive	+	
Simple		-

Example:

[to be inserted]

Useful References and Other Information:

APPENDIX TWO: Pilot Site Summaries

[@@@ Insert 1-2 page pilot site summaries once designated and testing completed.

Possible two-page (including map and photos) outline:

- *Setting and Threats*
- *MPA History*
- *Indicators tested and results*
- *In their own words: challenges and benefits from using the indicators]*

APPENDIX THREE: Methodological Primer

Much of the discussion in this Appendix is based on two references:

Bunce, L., P. Townsley, R. Pomeroy and R. Pollnac. 2000. Socioeconomic Manual for Coral Reef Management. Australian Institute of Marine Science, Townsville, Queensland, Australia.

Margoluis, R. and N. Salafsky. 1998. Measures of Success: Designing, Managing, and Monitoring Conservation and Development Projects. Island Press, Washington, DC.

Sampling Approaches

The Sampling Area

For purposes of this guidebook, the sampling area is the MPA site and immediate surrounding community or communities, including all the stakeholders within this area. For some purposes, such as the use of experimental design, it may be necessary to reference areas outside of the site. For most purposes, however, international, national and regional levels are outside of the scope of the sampling area.

The term 'community' can have several meanings. Community can be defined geographically by political or resource boundaries or socially as a community of individuals with common interests. For example, the geographical community is usually a village political unit (the lowest governmental administrative unit); a social community may be a group of fishers using the same gear type or a fisher organization. A community is not necessarily a village, and a village is not necessarily a community. Care should be also taken not to assume that a community is a homogeneous unit, as there will often be different interests in a community based on gender, class, ethnic, and economic variation.

Sampling Procedures

The assessment team needs to develop a sampling approach in order to determine *who* to interview and survey. The sampling approach will define how many informants within each stakeholder group the assessment team needs to contact and how to select those individuals.

There are two major sampling approaches to choose from when selecting individuals to sample: random sampling and non-random sampling (see *Table 1*).

Non-Random Sampling
In non-random sampling, the team chooses specific individuals as informants to gain an understanding of the different viewpoints, attitudes, perceptions and concerns held by the group at large. Because the informants are chosen rather than randomly selected from a clearly defined group, the information cannot confidently be regarded as representative of the group as a whole.

Table 1: Approaches for sampling, including advantages and disadvantages of each

Sampling Method	Method	Advantages	Disadvantages
Non-Random Sampling	oral history, focus group, observation, survey, semi-structured interview	Relatively inexpensive, not time-consuming, uncomplicated, does not require a well defined stakeholder group, can help to achieve a better representation of diversity in the population	Resulting data are not statistically representative of the stakeholder group
Random Sampling	survey, semi-structured survey	Data are statistically representative of the stakeholder group	Expensive, time-consuming, complicated, requires a well-defined stakeholder group (e.g., a list of all the stakeholders)

To overcome this statistical weakness, assessment teams need to select people who are likely to represent different perceptions and viewpoints. By seeking these people out, the team can try to build up a complex understanding of how different groups of people view local conditions and particular issues. Various methods of cross-checking between the information that different informants provide can help to build up the confidence of team members in the information that they receive from a non-random sample. However, a non-random sampling approach relies on seeking out diverse opinions rather than trying to generalize about the opinions of the larger group. In the process it will usually be possible to arrive at conclusions about opinions and perceptions that are held by broader groups of the population, but these will inevitably be *impressions* rather than *statistically sound findings*.

When to use non-random sampling

Non-random sampling is typically used when:

1. the team does not have the resources to conduct a full, statistically representative sample
2. the team wants to assess specific individuals
3. the stakeholder group is not well enough defined to select individuals at random
4. the team does not want to, or in unable to, analyze the data statistically (e.g. qualitative data)

This approach is particularly useful when conducting focus groups, oral histories, and observations, which typically involve interviewing particular individuals or observing specific events and involve qualitative data, which cannot be analyzed statistically. Non-random sampling is also often used for semi-structured interviews since these interviews can be time-consuming and the results are typically qualitative. This approach can also be used for conducting surveys when there is not enough time or resources to survey a statistically representative group or the team wants a rapid overview of the stakeholder group.

The main advantage to non-random sampling is that it is generally less expensive, less time intensive and less complicated than random sampling. It also does not require a well defined stakeholder group and can help to achieve a better representation of diversity in the population. However, the resulting data cannot be statistically analyzed and cannot, therefore, be taken as necessarily representing the perceptions of the stakeholder group as a whole.

***How to Select I*nformants**

The most common approach for non-random sampling is purposive sampling in which the assessment team uses their judgement in selecting stakeholders to sample. In most cases these stakeholders are key informants, who can provide insights regarding the larger stakeholder group. For example, the team may select the president of the hotel association and the original owner of one of the oldest hotels as the key informants for the hotel industry. This approach is particularly valuable for focus group interviews and oral histories, which require interviewing particular individuals. This approach to sampling can be extended using the snowball approach. In the snowball approach a purposively selected informant is asked to provide the names of other possible informants in the same stakeholder group. This process can then be repeated with each new informant until the same names are being recommended, at which point the group can be regarded as having being fully sampled. This extension of purposive sampling is most applicable where the groups being sampled are small enough to permit almost complete coverage.

An alternative approach to snowball sampling is sidewalk sampling (a.k.a., convenience sampling) in which the team interviews stakeholders who pass by and are willing to participate in the study. This approach allows the team to assess a large number of respondents at minimal cost. For example, if the assessment team is interested in interviewing tourists shopping for coral related merchandise, the team could interview tourists outside retail coral stores. Alternatively, the team may be interested in the purchasing behavior of tourists in coral curio shops. The team could observe tourists purchasing coral in curio shops for a few hours over several days. This approach is particularly useful for conducting semi-structured interviews, observations and rapid surveys.

Regardless of which approach is used for selecting individuals for non-random sampling, the team needs to ensure the full range of perceptions are represented. Older fishermen, for example, may have different perceptions of the cultural value of fishing from younger fishermen. The researcher, therefore, needs to interview both older and younger fishermen about the cultural value of fishing. Important characteristics to consider in identifying these range of perceptions include:

Gender

- Age (e.g., young fishermen, older fishermen)
- Socioeconomic levels (i.e., wealth, education, social standing)
- Occupational group (e.g., small-scale farmers, plantation farmers)
- Residency (e.g., tourist divers, resident divers)
- Ethnicity, tribal affiliation, and nationality
- Location (e.g., fishermen living by the landing site, fishermen living inland)

The team needs to use everything they have learned during the previous steps to identify those people who will provide the breadth of perceptions.

When selecting individuals the team will also need to bear in mind some of the guiding principles for field data collection below. In particular, the team needs to consider possible sources of bias, both among team members when they are purposively selecting informants, and among the informants themselves. It is often helpful to make simple, *ah hoc* sampling rules, such as selecting every fifth person who exits a shop, to ensure the team does not exhibit biases in who they select as informants.

The number of stakeholders that need to be assessed needs to be determined using the assessment team's best judgement. A general guide is to interview people until the responses become repetitive and no new information is being generated.

Random Sampling

If the assessment team feels that it is important to be highly confident that the results of their assessment are statistically representative of the stakeholder group, then they will need to select a random sample of informants. A "random sample" means that the people talked to have been selected without human bias influencing the choice – the probability of each person being selected as an informant is equal. In random sampling the team assesses a statistically representative sample of the stakeholder group. Consequently, the data are statistically representative of the larger group.

When to use random sampling
Random sampling is typically used when the team wants statistically representative data and has the time and resources to conduct this intensive approach. This approach requires that the stakeholder group is well-defined so that the team can randomly select individuals. The stakeholder group can be defined in a comprehensive list of all stakeholders (e.g., list of fishermen registered with the Fisheries Deparment, list of hotels from the Tourism Department). Alternatively a map of their locations (e.g., map of boats in a marina from a harbor master, property tax maps indicating locations of hotels), can allow the team to randomly select their sample and then locate those people to interview.

This approach is most appropriate for surveys, which are designed to elicit quantitative data conducive to statistical analysis. However, other methods, such as semi-structured interviews and observations, can also be conducted using random sampling. For example, if the assessment team is interested in the percent of dive boat anchors that hit coral heads when anchoring, then the team could select a statistically representative number of dive boats and observe their anchoring practices. Informants for semi-structured interviews can also be selected using random sampling; however, the results from semi-structured interviews are typically qualitative due to the exploratory nature of the questions and are, therefore, not conducive to statistical analysis.

The main disadvantages to this approach are that it is expensive, time-consuming and complicated and it requires a well-defined stakeholder group. In addition, determining the appropriate sample size often requires a statistician. However, the advantage is the data are statistically representative of the stakeholder group.

How to select informants
As a general rule, when selecting informants for random sampling, the larger the sample size, the greater the level of accuracy and the more certain the assessment team can be about extrapolating findings from the sample to the entire stakeholder group.

In order to determine how many informants to interview, the assessment team must first decide on two interrelated factors –their level of confidence and their confidence interval. The level of confidence is the level of risk the assessment team is willing to accept in the study. For instance, by using a 95% level of confidence, the team can assume a 5% risk that the confidence interval is incorrect, or be 95% certain that the confidence interval is correct. The confidence interval, or margin of error, determines the level of sampling accuracy obtained by the assessment team. For instance, by using a 10% confidence interval, the team can assume a 10% chance of error. Therefore, by using a 95% level of confidence and a 10% confidence interval, the assessment team can be 95% certain that their sample results are representative of the larger stakeholder group, +/- a 10% margin of error. For example, if the informants' average age is 50 and the informants were selected using a 95% level of confidence and a 10% confidence interval, then the assessment team can be 95% certain that the average age of the larger stakeholder group is 50 years old, +/- 10%, or between 45 and 55 years old.

There is no rule by which to choose a level of confidence or a confidence interval. Instead, the assessment team needs to determine these factors on a case-by-case basis taking into consideration the specific goals and objectives of the study as well as time and budget constraints. In particular, the assessment team needs to consider the sensitivity of the study results, including the potential consequences of these results if they are incorrect. If the study is particularly sensitive, the researcher may decide to use a high level of confidence and a high confidence interval (e.g., 99 percent level of confidence and a 1 percent confidence interval).

In general 99% is considered a high level of confidence, 95% is average and 90% is low. Similarly, a 1% confidence interval is high, 5% is average, and 10% is low. In most situations it is widely accepted to use a 95% confidence level and a 5% confidence interval. Table 2 lists the sample sizes for various stakeholder group sizes with levels of confidence of 95% and 99% and confidence intervals of 5%. It is logical that fewer interviews are needed to adequately represent a very small population, however it is important to consider possible biases of those individuals selected. For this reason, the sample size should be as large as possible for small populations if biases are known to be present among individuals in the population. In most cases, however, sample size does not need to exceed 50% of the total population that the sample represents (Rea and Parker 1997).

Having determined how many people to survey, the team now needs to determine *who* to survey. The assessment team can use the *simple random sampling approach* or the *systematic random sampling approach*. In the simple random sampling approach (a.k.a., "the hat method") the team numbers all the stakeholders either on the list of stakeholders or on the map of their locations and then selects stakeholders by: 1) selecting numbers from a table of random numbers (e.g., the first 2 digits of phone numbers in a telephone book), or 2) putting the numbers on small cards in a bowl or a hat and pulling a number, making sure to replace the card chosen so as to maintain the probability of choosing any card with each draw. This selection process is repeated until the desired sample size is reached.

Table 2: Number of informants to interview for various stakeholder group sizes (Rea and Parker 1997).

	Sample Sizes 95% Level of Confidence	99% Level of Confidence
Stakeholder group size	5% Confidence Interval	5% Confidence Interval
Less than 500	Varies, but generally no more than 50% of the stakeholder group	Varies, but generally no more than 50% of the stakeholder group
500	218	250
1000	278	399
1500	306	460
2000	323	498
3000	341	544
5000	357	586
10000	370	622
20000	377	642
50000	382	655
100000	383	659

Alternatively, systematic random sampling (a.k.a., "the walking method" or "interval method") is used when the the stakeholder group is very large, making it difficult to assign numbers to individual stakeholders for simple random selection. In this approach, the team selects informants from the list at fixed intervals. The stakeholders are selected in proportion to the percent of the population the sample should represent. For example, if the assessment team has identified 1000 fishing households and has determined that the sample size should be 400, then the assessment team should survey 400/1000 households, or 1 in 4 households. The team would then randomly choose a starting point between the first and fourth household on the list, and work their way down the list selecting every fourth name to survey. In the case of a map, the team could walk through the area selecting every fourth household to survey. This approach can be made more random by combining by selecting the house on the left or right based on the flip of a coin.

Data Collection

Designing the Strategy

Evaluation enables you to do an impact assessment of the MPA's interventions to determine whether you have achieved your goals and objectives and what you need to do to improve the MPA. In order to be able to measure the impact of each of the MPA's interventions, you need to be able to compare the results of your interventions to some benchmark. These comparisons involve groups of individuals that are drawn from a defined population. There are basically two types of comparisons that you can make in evaluation: 1) Comparing a group affected by your MPA to itself over time. This comparison involves measuring how a given factor changes as a result of MPA activities. This type of comparison does not necessarily establish causal relationships.

2) Comparing a group affected by your MPA to a group not affected by the MPA over time. This comparison involves measuring how a given factor changes in a group affected by the project relative to a similar group that is not influenced by the project. This type of comparison can help establish causal relationships.

There are two main ways to compare a group affected by your MPA to itself over time: 1) pre-test/post-test monitoring design, and 2) time series monitoring design. The pre-test/post-test monitoring design involves measuring your group of individuals before your interventions to establish a baseline, implementing the interventions, and then remeasuring the group to see how it has changed as part of a follow-up. The time series monitoring design involves collecting data multiple times before and after the project interventions.

There are two main ways to compare a group affected by your MPA to a group not affected by the MPA over time: 1) strict control monitoring design, and 2) comparison group monitoring design. The strict control monitoring design, also referred to as 'experimental design', involves taking all individuals in the population and randomly dividing them into two groups. One is the treatment group which will be subject to the MPA interventions, and the other is the control group which will not be subject to the MPA interventions. The treatment group is compared to the control group to determine if the project had an effect. The comparison group design involves comparing the treatment group with a deliberately selected and "matched" comparison group to determine whether the MPA had an effect.

Planning for Field Data Collection

The data collection should be planned in detail to ensure that the assessment team will enter the study sites prepared to collect the data effectively and efficiently. Planning the field data collection involves several steps:

Identify the methods and visualization techniques
Having decided on the parameters for the assessment, the team determines the methods and visualization techniques for collecting the data. Field data collection methods may include survey, semi-structured survey, observation, focus group, and key informant interview. Visualization techniques are analytical tools for visualizing and diagramming relationships among data, such as mapping, matrix ranking, timelines, and flow charts. When considering which methods and visualization techniques to use, the team should consider to what extent the team members are familiar with the methods and techniques. When a team is not familiar with a technique, they should plan a training and practice.

Prepare materials and tools for the methods.
Each method and visualization technique will have material requirements to carry it out. This may range from paper and pen to cameras, binoculars and GPS. Most importantly, the team should prepare the tools for the interviews and surveys. For the semi-structured interviews, focus group interviews and oral histories, the team should prepare a list of questions to guide these interviews. For surveys, a questionnaire needs to be prepared which includes more specific, close-ended questions than the interview guides. Although the team does not need to develop interview guides or questionnaires for the

visualization techniques, they do need to consider what topics need to be addressed for each technique and how to facilitate the process.

Data collection and recording needs to be conducted in ways that are systematic, standardized, and accurate. The term systematic refers to collecting and recording the same data for each individual observation that you are making. This is best done using a structured data collection sheet. The term standardized refers to collecting and recording data in the same way for each observation. All team members must collect and record data in the same way compared to one another and over time. The term accurate refers to collecting and recording data with a minimum of error. The most common sources of error are interviewer, respondent, data recording, and data coding errors.

***Pre-test the interview guides and questionnaire*.**
Before using the interview guide and questionnaires in the field, the team needs to test them to ensure that the questions are easily understood, flow naturally, are culturally and politically sensitive, and elicit the desired response, and can be conducted in a reasonable time period (less than 45 minutes).

***Decide how to keep track of information*.**
The team should develop a system to keep track of all the information that is being collected. The tracking system should keep account of what information is being collected for which stakeholder group and on which parameters, where the information was collected, who collected it, and which data collection methods and visualization techniques were used. The tracking system also should keep track of which type of informant was interviewed during the semi-structured interviews, oral histories and surveys and the characteristics of the informant.

***Handling and Storing Data*.**
A great deal of data and different types of data will be collected. This data will need to be organized as it comes in. This involves coding data. The team should consider how they are going to code their data as they collect it. Coding helps the assessment team to reference their field notes to particular parts of the tracking system and will be useful in synthesizing and analyzing the data according to stakeholder groups and parameters. Reviewing the coded data for obvious recording error and gaps. Transcribing the data in a systematic format. Entering and organizing the data in a spreadsheet, database program or statistical package. Backing up the data by making duplicate copies for storage. Cleaning and preparing the data for analysis by going over it to catch any errors introduced in any of the previous steps.

***Define plans for analysis*.**
It is important to understand how the data will be analyzed before starting field data collection. Most assessments will have two different sets of information: (a) qualitative information primarily collected through semi-structured interviews, focus group interviews, observation and oral histories, and (b) quantitative data primarily collected from surveys, which are more structured. Qualitative information should be continuously analyzed while it is collected. This analysis should occur during field analysis workshops where the team meets regularly to review what they have done, how they did it, and what they have learnt. More planning is needed for analyzing quantitative data, which often involves designing a database to analyze the data. The team should determine what type of information they expect to produce from the analysis and decide how they will use the results.

The team should consider:

- what kind of analyses will be done, including simple calculations, descriptive statistics and more advanced statistical analyses;
- what tables, figures and graphs will need to be produced; and
- how these tables will be used to explain which parameters and which stakeholders.

The team should design a database to record, analyze and produce the required sets of information using a computer program such as Microsoft Excel or Access.

Decide on sampling unit.
The team should define the basic sampling unit, which is the type of person(s) or stakeholder group(s) the team plans to interview and survey.

Decide who to interview and survey.
Next, the team should determine who to interview and survey, including how many informants within each stakeholder group they should contact and how to select those people. Since it is not usually possible to interview all the stakeholders, the team should select a sample of the group, which will be used to understand the entire group.

Establish the field teams.
Decide the composition and size of the field team. Smaller teams of 2 or 3 people, if that many are available, have more advantages than larger teams. The field team should assign roles to the members such as facilitator, record keeper, and 'gate-keeper' to observe the process. The team should establish their rules of interaction between each other. Decide whether the is composed of MPA staff, volunteers, community members, or outsiders. Decide on who will supervise the field teams.

Define the schedule for the field data collection.
The team should prepare a schedule for conducting the field data collection, including a timetable and allocation of tasks to team members. The schedule should be based around the list of the stakeholder groups and local events, work schedules and seasonality.

Train team members in data collection methods and visualization techniques.
All team members should be trained to conduct the range of methods and visualization techniques and to ensure they understand the goals and objectives of the assessment. It is essential that team members understand why the questions are being asked, what they mean, and the expected type of responses.

Provide a briefing on the local culture.
The assessment team should understand as much as possible about the local culture before starting the field data collection. They should be briefed on local customs, traditions and behaviors, and particular etiquette.

Arrange logistics.
After finalizing the structure and content of the field data collection, the assessment team should address the practical details of preparing for the field data collection. The team needs to inform the stakeholder representatives and any other appropriate local authorities when the team will arrive and any permissions or clearances. Logistics

include transportation, meals, and accommodations. The team should also have a meeting place for themselves and to be used for interviews.

Guiding Principles for Field Data Collection

Field data collection depends on the skills, flexibility and inventiveness of the team and on the relationships they establish with the stakeholder groups. Following are some guiding principles that the team should follow throughout the field data collection:

Respect the stakeholders and communities
Team members must respect the stakeholders, particularly their knowledge, time and customs, as a matter of courtesy. This respect will benefit the team by helping them gain the trust of the community members. In particular, the team should recognise the stakeholders' knowledge of their communities and resources, which can greatly assist data collection. The team should minimize disruption of the stakeholders' and communities' daily routines by selecting times for interviews and meetings that are convenient to the stakeholders and by limiting the time taken for these activities. As a general rule, interviews and surveys should be kept between one-half hour to one hour, depending on the cultural norms. The team must follow local customs, particularly since they may be perceived as disruptive and a potential threat to established power structures, and to the habits, traditions and norms of a community. Following these customs helps to ensure the team is accepted by the community and can work in an atmosphere that is relatively free of tension.

Clarify the objectives of data collection
The team should always consider what impact they are having on stakeholders and whole community by their presence and the questions they ask. A visit by outsiders to rural communities may be a rare event and people may be as curious about the team as the team is about them. The team should also be aware that stakeholders and other community members will interpret the team's presence according to their local reality and may presume that there are hidden reasons behind their visit, other than those revealed to them. The team cannot assume neutrality within the community. Therefore, the team should be direct and clear with the community, stakeholders, and particularly informants regarding who they are and their objectives. The team should make it clear that they are there to learn from the community, not to impose their own knowledge on them. These points should be continuously repeated throughout the data collection. Visual tools, such as a flow chart, can also help stakeholders understand what is being discussed and how it is being analyzed. Stakeholders, particularly informants, should be given time to ask questions and satisfy their curiosity about the team members. Participation of stakeholders as team members can also help increase their confidence in the process.

Develop an interactive approach
Quality data collection depends on interactive, two-way communication between the team and the stakeholders. An interactive approach helps the assessment team explore topics that arise unexpectedly, question responses that are unclear, and directly confirm analysis with the stakeholders, all of which are critical to understanding complex, multi-dimensional socioeconomic conditions. In addition, the more comfortable the informants feel with the team, the more likely they are to trust them, to be open with them and to provide in-depth, honest responses. The interactive process itself can be revealing e.g.

the facilitator may find that some group members defer to others during an interview, indicating a hierarchy within the community. By developing positive relations with the stakeholders, the socioeconomic assessment may be the first step toward involving local stakeholders in management. This interactive process *also* enables the stakeholders *themselves* to develop a fuller understanding of the socioeconomic conditions in their community and gain a greater sense of ownership of the process and results. Increasing the level of comfort and trust between team members and informants means making a conscious effort to become familiar with the stakeholders by meeting them informally in their own setting. Two-way interactions range from interviewing the president of the fishermen's association at the landing beach, to talking informally to the president of the small farmers association at the local bars.

Recognise the limitations of information

Regardless of any success in establishing a strong rapport with stakeholders and developing trust and openness, the team should recognise there are limits to these interactions. Anthropological research in communities often lasts for years before the local people really begin to open-up to the researchers. Spending a few days to weeks or months in an area will not allow the team to be taken into people's confidence. To overcome these limitations, the team should consider involving stakeholders in the field data collection and analysis. Stakeholders already have a rapport with other stakeholders and are, therefore, more likely to be given access to accurate information. Stakeholders also understand the community dynamics.

Recognize informants' biases

Stakeholders will have different perspectives, perceptions, priorities and interests. One purpose of the assessment is to solicit that diversity of perspectives by interviewing a range of stakeholders. However, the *individual* perceptions of informants need to be kept in mind when interpreting their responses because they can constitute an individual bias. By recognising these potential biases, the team can better understand how representative these views are of the larger group. For example, a traditional community leader may emphasise the value of traditional rules because they enhance his status, when other members of the community generally consider their influence to be much more limited. The informants' perceptions of what the assessment team is doing, and possible benefits to be gained or losses incurred from giving the assessment team certain information, may affect their responses.

Assessment teams can overcome these problems of informant bias by:1) being fully aware of *who* different informants are and what stakes they might hold in the coral reef and its use; 2) clearly explaining to informants *who* the team is, *why* they are there and *what* they are interested in talking about; 3) cross-checking information generated from different informants, identifying contradictions and disparities; and 4) following up and probing issues that have given rise to contradictory responses from informants. Another form of bias is the effect of the surroundings where the interview or survey is conducted. For example, informants may respond differently when other stakeholders are around to when they are alone. To control this, the 'gate keeper' may try to restrict entry into the interview or survey area. Where the surroundings cannot be controlled, the team needs to note this and exercise judgement in assessing how this may affect responses.

Recognize and minimize biases of the assessment team and its members
The perceptions of the team members are shaped by their environment, background, culture and knowledge. These biases can lead them to interpret what they see and hear in ways that fit into their views and perceptions. This can be a problem when the team members' views and perceptions differ from the stakeholders.
Assessment team members cannot entirely eliminate these biases, but they can learn to recognize them and become self-critically aware of how these may affect their interpretations of what they see and hear. Being 'self-critically aware' means continuously and critically examining their own behavior and perceptions, accepting errors, and learning from them. This can reduce biasing their interactions and interpretations.

Following are some of the most common biases and measures that can be taken to minimize them.

- **Gender**

Women may be excluded from the field data collection, or their opinions under-valued, if team members discount the importance of women's opinions and viewpoints. This occurs more frequently among male team members. Gender bias is a concern because many organizations that conduct assessments are dominated by men, leading to predominantly male assessment teams. This creates a problem when cultural norms make it difficult for women to talk to outsiders.

The team can address this bias by:

- Talking specifically with women as a separate stakeholder group;
- Including women on the assessment team; and
- Including a gender specialist to specifically address gender related issues arising during data collection and to control gender bias in the assessment team's work.

- **Roadside**

When some sites are difficult to access, assessment may be concentrated on easier-to-reach areas. Arguments can be made because this saves time in travel and more accessible areas tend to be more populated as well. But ease of access also often means more options available to people and better overall conditions. If the team focuses on these, they may miss areas with greater problems, more poverty, limited options, greater dependence on reef resources and where the impacts of eventual reef management may be more severe.

The team can address this bias by:

- making a conscious effort to identify and reach less accessible, poorer areas far from roads, even if it requires more time and effort; and
- exploring the study area on foot to ensure that they reach areas that are not easily accessed by road.

- **Rich, urban and educated**

For educated, articulate members of a team, accustomed to urban society and certain norms of communication, it is easier to talk to community members who are most like themselves. This generally means the better-off and better-educated in rural areas. Often these people can be key informants, and provide an analysis of local conditions that is more informed and more articulate. But this may lead to errors of thinking that, because people talk and think like themselves, they must be impartial and balanced in their judgements. These perceptions of local conditions can be considered as the truth at the expense of less clearly articulated and more difficult to understand from others. Similarly urban-based team members may place greater importance on reef activities and products that relate to urban life (e.g. fish seen in urban markets, corals used for jewellery in urban stores). Entire sets of resources and patterns of use may be overlooked as a result.

These biases needs to be balanced by:

- analysing the backgrounds and potential biases of the various informants;
- identifying and assessing the non-urban activities, resources and stakeholders; and making special efforts to communicate with groups that are difficult to talk with (e.g. the poor, old people, children)

▪ **Outsider priorities**

Any assessment has its own objectives, often largely determined by issues regarded as important by outside organisations or end-users. Even if stakeholders have been consulted extensively, outsider priorities may still dominate when it comes to deciding what to talk about in the field.

The team can address this bias by:

- reflecting on the objectives, priorities and concerns identified by the stakeholder representatives during the initial consultations and reconnaissance survey;
- consulting with the stakeholder representatives, key informants and other stakeholders as often as possible regarding plans and progress with the field data collection; and
- asking general, open-ended questions during the interviews to allow the stakeholders to discuss topics they regard as important.

▪ **Language**

Often the assessment team must talk to stakeholders using a language other than local people's everyday language. This can lead to bias in several ways: translators can introduce their own interpretations into translations for the team; local people may express themselves poorly in a different language and distort their own meanings unintentionally; when the language used is some kind of official language, local people may be accustomed to only talking about certain things (such as official matters) in that language and not about others (such as local traditions), which can limit the information they get across; and even if outsiders and local people speak the same language, the way they use that language can be so different that true communication may be limited and the team may misunderstand what is being said.

The team can overcome these biases by: making sure that the team includes people who speak the local language well; and analysing carefully *how* information has been generated, recognising the potential for misinterpretation of what they have said to local people and visa-versa.

▪ **Disciplinary/academic background bias**

Team members may have specialist training in an academic discipline, which can condition their perceptions of what is important e.g. a fisheries specialist talking to reef users may focus on fisheries-related issues because these are familiar and considered important. Unconsciously he may encourage informants to talk about fisheries as well, even though fisheries may be only one, relatively unimportant, use of the MPA. Similarly, someone with formal scientific training may concentrate on trying to establish facts that can be demonstrated, and discount the important perceptions, opinions and attitudes of stakeholders that are based on experience, observation and tradition. These biases can be overcome by: making sure that assessment field teams include people from different disciplinary backgrounds – such social and natural sciences; initiating interviews with open-ended questions that allow informants to describe their own priorities; checking as a team on the extent specialists tend only to collect data on their specialist area and discussing how this can be overcome; and cross-checking data and ensuring the team has opportunities to reflect on what they have learned and adjust the rest of the assessment accordingly.

- **Take detailed notes**

Throughout the field data collection the team members should take thorough, detailed notes, which are critical for the analysis e.g. quotes can be particularly powerful. The notes should include not only *what* is said, but also *how* things are said, which is often just as insightful. These notes may include information on the informants' attitudes and demeanors, subjects they avoid, how much time they spend on different subjects and their interactions with each other.

- **Cross-check data**

Cross-checking data is critical and involves comparing data to determine how thoroughly the stakeholder groups and parameters are being assessed. It also helps in assessing the reliability of the information and identifying potential biases. Cross-checking is based on the principle of triangulation in which the assessment team compares data from at least three different sources, three different team members and using at least three different data collection methods. Where conflicting information is received about a parameter, triangulation can help establish the extent the information reflects the perspective of the particular informant or the opinion of the larger group. The team should meet regularly to compare information and findings, looking for inconsistencies and contradictions in the information. Using triangulation as a guide, the team can plan further field data collection to check information that is unclear or requires more in-depth study.

- **Create opportunities to reflect on learning**

The team needs to create opportunities to reflect on what they have learned. These reflections help ensure an adaptive planning process and improve the team's quality of understanding. Instead of only having one opportunity to collect information about each topic, or from each set of informants, the team can go back over areas they have already investigated to clarify contradictions or issues. The main opportunity to do this will be during the regular field analysis workshops.

- **Recognise when to stop**

As data accumulates, it is easy for teams to fall into the trap of thinking they need more. The collection of as much information as possible can become an end in itself, resulting in a mountain of interesting, but not necessarily *useful*, information. An assessment will be judged on the relevance of the findings, not on the amount of information.
Knowing when to stop requires judgement by assessment leaders and critical self-awareness among the team members. The team members should ask, "Are issues being followed because they are interesting, or because they will really contribute to the

assessment?". The Tracking Worksheet can help decide if the team has enough information on all the parameters and stakeholders. Control over the quantity of redundant information being collected has to be balanced with the need to allow space for new learning that were not anticipated.

Final Data Analysis

During this final phase, the assessment team analyzes and validates the data and presents it in a useful format for the end-users.

Much of the data analysis, particularly the analysis of the qualitative data, should have been carried out during the field analysis workshops. Therefore, the final analysis involves:

0. Refining the key learning;
1. Collecting and ordering data to illustrate key learning;
2. Presenting the key learning in an accessible form for the end-users;
3. Validating the key learning with stakeholders; and
4. Incorporating the key learning into a report.

Key learning refers to issues identified or lessons learnt by the team that are essential to the objectives of the assessment or are needed to understand the socioeconomic context of the stakeholders. Key learning can take many forms, including:

a) a set of information that is critical to the objectives set for the assessment; conclusions about a particular parameter;

b) a cross-cutting issue that draws on what the team learnt about several different parameters;

c) an issue or group of issues that are priorities for a significant proportion of stakeholders;

d) a particular problem that most stakeholders agree is important;

e) an activity, problem or issue that the team have identified as having a significant impact on the MPA;

f) a question that has not been answered and that may require further research; and

g) an important conclusion by the team on local conditions, local resource users or any of the other factors effecting socioeconomic aspects of MPA use.

In most cases, key learning will be identified by team members during informal discussions of their findings. By comparing what they have been told during interviews or what they have observed, the team can identify similar patterns and new insights relevant to the assessment goals and objectives.

Basic Principles for Analysis

The following guiding principles should be followed throughout the final analysis.

Involve all the assessment team members in the analysis
No matter how carefully the team has recorded their data, much important learning from an assessment will still be in the heads of the team rather than on paper. Therefore, all the team members need to be involved in analyzing and reporting the results.

Prioritize quality, not quantity*.*
The success of an assessment is not measured by the *quantity* of information it generates but by the *quality* of that information. Quality is judged by: the extent to which the reported findings reflect the collected information the usefulness of the findings to end-users.

This principle is particularly important for qualitative analysis, where the assessment team needs to focus on information relevant to the goals and objectives of the socioeconomic assessment. In contrast, in the case of statistical, quantitative analysis the quantity of data is important to ensure the required sample size is met.

Prioritize learning, rather than information
It will not be possible, nor useful, for the assessment team to report all the information that was collected. Instead, the team needs to focus on the key learning generated from the collected information.

Do not modify the results to the end-users' expectations
The assessment team must avoid the temptation of modifying the results to accommodate the end-users e.g. if the funding organization is particularly interested in poverty, but the assessment team found that the stakeholders are not poor, then the team should not describe the situation as if they were.

Conduct the Data Analysis

There area several critical steps involved in conducting the field data analysis.

Compile the information
The team first should assemble all the information obtained throughout the assessment. The Tracking Worksheet can help identify all the sources of information, including:

0. Information from consultations with stakeholder representatives, secondary data sources and the reconnaissance survey should already have been reviewed and synthesized since this information was used in the initial planning of the field data collection.
1. Written notes from each team member during data collection should have been synthesized in field analysis workshops. The team members may need to spend some time ordering and reviewing their notes.
2. Visualizations diagrams from the field data collection should be readily available from the field notes with minimal revision and the team should already have a good idea of the most valuable ones for analysis and presentation of data.
3. Depending on how much preliminary analysis has been conducted, some of the quantitative data should already be analyzed and available.
4. Outputs of the field analysis workshops should be available since these were compiled following each workshop.

Prepare the quantitative data
The main part of the information set that may not be immediately accessible are the quantitative data from the surveys. During the field analyses workshops, preliminary analysis were conducted of the survey data, and the team should now complete these analyses and produce tables of key sets of information. If this information is not available during discussions of the data, the chances of it being used effectively are significantly reduced, as quantitative data should be discussed and compared with the qualitative data.

The quantitative data may be analyzed using relatively simple calculations, such as sums and percentages e.g. if census data indicate occupation, then the total number of people in each stakeholder group and the percentage of the population in each occupation could be calculated. Trends over time may also be calculated in total numbers or in percentages e.g. the total number of fishers may be reported over a ten year period as well as percentage changes between the years. Comparisons may also be conducted between parameters e.g. the number of fishers over time may be calculated and compared with the catch rates to identify possible correlations. The results from these simple calculations may be presented in graphic form, including pie charts, tables and diagrams. Descriptive statistics, including standard deviations, means and modes, and t scores, may also be calculated; however, these analyses require an understanding of basic statistics. In addition statistical analysis requires that the data be collected from a statistically representative sample.

The analysis of quantitative data needs to be carefully compared with the data collected from the other sources and reasons for discrepancies need to be discussed by team members taking into account possible bias of team members that may be affecting their learning in the field; in the design of quantitative surveys; and in the way in which the surveys were conducted.

Where serious discrepancies cannot be explained, it may be necessary to collect additional, focused data. This involves taking the contradictory information back to key informants for further discussion and validation to sort out these contradictions.

Assemble for a final analysis workshop
All the team members should gather for a workshop to review, analyze, and report the findings. The workshop is the best mechanism for the analysis and finalization of the assessment findings because it: Allows comparison and discussion of findings; Draws on the different experiences and viewpoints of team members; Allows for other people, including end-users and stakeholders, to be involved; and Can speed up the entire process of analysis and report production significantly by focusing the assessment team on the analysis.

Outline the final report
The assessment team should decide what type of final report is required. This will depend on the goals and objectives of the work and what format will be most useful to the end-users.

One critical aspect that will need to be assessed is how much description is required as part of the outputs. Some end-users, such as senior policy or decision-makers, may have little interest in a general description of the area and communities that have been studied and they may be more interested in an output that focuses on issues, problems and potential solutions. Other end-users, such as researchers, may be interested in detailed descriptions of the different aspects of the socioeconomic context of the MPA.

At the same time the assessment team needs to determine how much quantitative data needs to be included in the final report. Socioeconomic assessments in which monitoring is the major objective may need to identify quantitative indicators in which case quantitative data will be needed to identify these indicators. The MPA manager may also use the quantitative data to serve as baseline information to monitor changes in socioeconomic conditions in the community over time. In cases where policy is the major objective, decision-makers may want a precise understanding of the quantity of impact of alternative policies to determine where to allocate limited resources. Alternatively, the MPA manager may be seeking more explanatory reasons for socioeconomic conditions and more information on the major issues and concerns, in which case quantitative data may not be a priority.

Finalize key learning

After field data collection, the team should have a strong idea of the key learning they want to draw out of the analysis and these should be contained in the outputs of the field analysis workshops. The team needs to review the key learning in comparison with the other sources of data compiled for the final analysis workshop. Key learning should be clearly laid out and matched with assessment objectives to see how they contribute. Through this process the team should synthesize results, share their conclusions, and discuss their insights and recommendations.

Once the team has agreed on key learning, the task of analysis of their findings will become much easier and the analysis will have a clear goal – to demonstrate and illustrate the key learning.

Identify information to support key learning

The information that has generated key learning should be clearly identified by the team. Usually, the information on the parameters can provide a guide for ordering. Regardless of whether the key learning is a conclusion about a particular parameter or is a cross-cutting issue, the team can lay out the various parameters examined and review how the information collected about that parameter contributed to the key learning.

The main points that illustrate the parameters identified as contributing to key learnings should be drawn out of the available information. These could take a variety of forms:

- Material quoted from secondary sources
- Written accounts of information acquired during the assessment
- Verbatim records of responses by stakeholders (i.e., quotes)
- Diagrams or visualizations generated by stakeholders during field work
- Tables of information generated from quantitative data
- Graphs or diagrams generated based on quantitative data

Validate the findings

Once key learning, parameters and illustrations have been decided, the team needs to prepare a presentation that will allow for these findings to be validated. Validation is a process through which the team presents their key learning to the stakeholders so that they can comment on the conclusions that the team has drawn.

The key learning should be illustrated in concise form, wherever possible using the visualizations that local people have themselves used during the assessment. Long, verbal explanations or complicated tables of data generated during the assessment may be difficult to understand.

Validation can take place in various forms:

- small discussion groups with key stakeholders
- presentations to specific groups of stakeholders or interest groups
- presentations to groups of selected representatives of different stakeholder groups
- community meetings involving a wider range of stakeholders.

Each of these approaches has its good and bad points. Smaller groups are easier to manage but divergences in opinions regarding findings are less likely to emerge. Community meetings involving a range of stakeholder groups are more difficult to manage and can give rise to expectations among those involved; however, they can provide a forum for discussing different opinions and attitudes regarding the assessment findings.

The discussions that take place in validation meetings need to be recorded carefully and the results incorporated into the final output of the assessment. In cases where the stakeholders disagree with some of the results, the assessment team will need to use its judgement to decide whether or not to change their results based on what the stakeholders tell them. Alliteratively they may decide to conduct additional, focused field data collection to clarify these discrepancies.

Prepare the report

Having addressed the results of the validation workshop, the assessment team can now prepare the report using the previously defined outline. Key learning should have its own section in which each key learning is discussed along with the relevant data to support these findings and using visualizations where appropriate. If descriptive sections regarding the stakeholders and parameters are included, then these may form their own sections in the text or may be included as an appendix.

Distribute and discuss report

Finally, the report should be circulated to the end-users and also presented in a forum where key learning can be communicated and discussed.

APPENDIX FOUR: Generic MPA Goals, Objectives, and Indicators

[@@@Insert Final (refined) Venezuela; Matrix of Goals, Objectives, and Indicators]

APPENDIX FIVE: Case Studies in Using this Guidebook

[@@@ Insert full case studies on selected pilot sites; perhaps separate manuscript ??]

World Commission on Protected Areas – Marine (WCPA-Marine) of the World Conservation Union (IUCN)

http://wcpa.iucn.org/biome/marine/marine.html/

Endangered Seas Programme of the World Wide Fund for Nature (WWF)

http://www.panda.org/endangeredseas/

National Ocean Service (NOS) of the United States National Oceanic and Atmospheric Administration (NOAA)

http://www.nos.noaa.gov/